1967

The Impact of Technological Change on Industrial Work in the Telephone Equipment Industry

Frank Edward Kimmel
Loyola University Chicago

THE IMPACT OF TECHNOLOGICAL CHANGE ON INDUSTRIAL WORK IN THE TELEPHONE EQUIPMENT INDUSTRY

by

Frank Edward Kimmel

A Thesis Submitted to the Faculty of the Graduate School of Loyola University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Industrial Relations

June

1967

APPROVAL SHEET

The thesis submitted by Frank Kimmel has been read and approved by three members of the faculty of the Institue of Industrial Relations.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Science in Industrial Relations.

May 25, 1964 — Date

Julius Rezler — Signature of Advisor

ABSTRACT

This empirical study describes the impact and importance of technological change as related to the industrial work situation in the telephone equipment manufacturing industry. Data are presented to show the effects of advanced mechanization or automation on employment, jobs and job content, wage rates, and workers and unions. The influence of technological change on these factors and the relationship of associated industrial work aspects selected to evaluate the magnitude of impact are illustrated. It is indicated, for example, that while considerable work force displacement and job change results, the needs of the business, whether through expansion or new product lines, absorb surplus workers and compensate satisfactorily by creating other work. Wage rates are generally effected favorably and worker welfare is protected in transition. It is concluded that the extent and complexity of automation can produce varying effects on certain aspects of the industrial work situation. A continuing need to stress greater joint problem solving on the part of engineering and manufacturing organizations, in providing more completely for solving changes to the industrial work situation, is highlighted. More motivational measures are indicated necessary to permit greater employee personal accountability. This will contribute to more successful worker adaptation to change and resultingly greater production.

LIFE

Frank Edward Kimmel was born in Chicago, Illinois, May 7, 1924.

He was graduated from Steinmetz High School in Chicago in February 1942, and from the Illinois Institute of Technology in June, 1945 with the degree of Bachelor of Science in Mechanical Engineering.

He began his graduate studies at Loyola University in September, 1963. Since April, 1946, he has been employed as a manufacturing engineer and has held various supervisory positions with the Western Electric Company, Inc. in the last twelve years.

The author currently has several published articles in engineering professional society and management periodicals covering the engineering management field.

He has been a member of the Western Society of Engineers since 1953.

TABLE OF CONTENTS

Page

CHAPTER I

INTRODUCTION

Importance of Topic. In the last twenty years there has been much written and many general contentions made in connection with automation's affect on such topics as employment, jobs and job content, wage rates and methods of payment and lastly, unions and related industrial relations aspects.

It is time therefore, to introduce an empirical study in an attempt to disclose both the impact and the importance of technological change as related to the industrial work situation in the telephone equipment manufacturing industry.

The writer has chosen the subject of this thesis for methodological research for the reasons as follows:

1. To present a picture of the effects of technological change on specific work factors in the telephone equipment manufacturing industry as so many people are employed and are involved in the process.

2. To make a contribution to the manufacturing engineering profession's effectiveness by reporting on work conditions which are influenced by technological change. It is therefore hoped that this will serve as a guide for enhancing the positive aspects of technological advances and to avoid or minimize any negative social consequences.

In the last half of the twentieth century, continued technological change is nothing more or less than one aspect of the never ending process by which managers seek to increase production, improve efficiency and product quality and to decrease costs with a view toward maximizing profits. Progress in mechanization and technological advancement has continued to result in new and cheaper methods and machines, and has accordingly intensified competition. At the same time, the well publicized profit squeeze has increased the pressure on management to improve its operations, and has placed an extremely high premium on management's freedom and flexibility to innovate and to adapt to changing competetive conditions. Wage and fringe benefit costs, in rising steadily, have left no alternative for management but to redouble its efforts in search for means of controlling or reducing costs and maintaining competitive prices.

One of the key problems of the manufacturing engineer as part of management, is to recognize daily the related importance of changes in adjustments to the labor force among other factors, caused by introducing technological change of one kind or another. For example, even though technological displacement of workers has been and will continue to be minimized by such factors as the increased requirements for maintenance personnel and newly created positions, the problems of worker adjustment to change job content, employment, wages and the work situation in the overall, is also significant for adequate consideration.

Faunce highlights existence of the foregoing problem areas by stating,

"Although study of the work group has always been one of the

> important concerns of industrial sociologists, the effect of changing production technology upon work groups has received relatively little attention."[1]

Methodology Employed. The basic part of this empirical study comes from a survey of engineering supervisors, project engineers and associated shop supervisors employed in various plants of the Western Electric Company Incorporated. These individuals have the responsibility of actually planning, justifying, installing and in all respects, bringing technological change to successful completion. Some have the experience of being associated with many advanced mechanizations, while other respondents have at least the knowledge gained of a few. These individuals who were and/or are closely connected with technological changes or automations, as defined herein, were canvassed then primarily, because they were the engineering supervisors who directed, project engineers who actually installed and shop supervisors who really had a hand in controlling various mechanized manufacturing processes, within the last five years.

To secure additional perspective, the writer has reviewed all writings, periodicals, and related empirical studies listed in the bibliography. In addition, as a supervisor of manufacturing engineers, the writer was in charge and directed the introduction of many technological changes and all related phases thereof. This therefore, provided further supporting background contributing to this study.

The kind of broad perspective as well as factually detailed comprehen-

---

[1] William A. Faunce, "Automation in the Automobile Industry: Some Consequences for In-Plant Social Structure, "American Sociological Review, 23, No. 4 (1958) p. 401.

sive information desired, could only have been secured from the categories of individuals enumerated in the foregoing as having management's wide scope of responsibility, rather than the worker's limited view. In this respect, facts rather than feelings were solicited from directly accountable people who are sincerely interested in accurate results with which to measure their projects' success and also to do better and a more effective job in the future with the employee's welfare in mind.

A questionnaire (see appendix I) was sent to all 150 engineering personnel and shop supervisors in the 15 Western Electric plants whose job titles indicated they were involved in various kinds of technological change. This questionnaire totaling 110 questions, was structured to cover four specifically related areas associated with technological change: jobs and job content, employment, wage rates, workers and unions including industrial relations aspects. In thoroughly covering and delineating these factors related with the thesis subject, pragmatic cross-validity checks by wording questions in different ways were introduced to assure reliable results.

Therefore, it was significant that some 47 respondents out of the 150, returned fully completed anonymous questionnaires, or about 1/3 of the population solicited. Data and information gained from the questionnaire were supplemented by telephone and personal contact, where additional information was required in addition to the writer's personal experience in introducing various degrees of automated work. This did not destroy the anonymity as all direct and indirect replies did not describe a particular instance, but were grouped and categorized as required.

The division of respondent returns was: 23 engineering supervisors, 4 shop supervisors and 20 project engineers to total 47.

Practically all respondents were contacted on a followup basis at least once and in several cases, frequently. This was usually, to clarify certain points and secure additional depth response.

The design of the research was such that a sizable number of diverse manufacturing situations were covered in general, where technological innovation had occurred. In this respect, 68 per cent of the respondents indicated their experience in connection with technological change, covering modernization of existing manufacturing processes as compared to 32 per cent who were involved in introducing an entirely new process.

Penetrating further to secure a better understanding of the broad nature afforded by the technological changes involved, respondent reporting was categorized as follows:

TECHNOLOGICAL CHANGES	NUMBER OF RESPONDENTS	% OF TOTAL
Automatic Assembly	24	51
Automatic Assembly and Testing	9	20
Automatic Loading	5	10
Mechanizing Complete Manufacturing Process	5	10
Miscellaneous Mechanized Operations (Winding, insertion, hot rolling & testing)	4	9
TOTALS	47	100%

In comparison with the previous general observation, it was specifically found that 18 per cent of the respondents had experience with various stages of mechanizing entirely new products. New mechanization techniques were incorporated directly into the setup of new product manufacture. Fifty-two per cent of the respondents had experience with replacing existing methods of manufacture on older stabilized products; whereas the remaining 30 per cent were able to automate the manufacture of a modified product, e.g., by securing Bell Telephone Laboratory approval to combine several parts into one component and/or substituting a metal joining operation for a conventional mechanical fastening method, advanced mechanization of the product manufacture was facilitated. A portion of this activity was associated with both existing manufacturing facilities and entirely new processes.

In addition to material secured from questionnaires and followup interviews, this thesis is also based on available company records, including personnel information, job descriptions, incentive plan application, production records and the writer's personal work experience.

For reader clarification, it is the "Western Electric" portion, the manufacturing unit of the Bell System with which this thesis will be concerned.

Review of Previous Research. It has been found that more text, reports and periodicals on the effects of automation have been written on a theoretical basis than have been presented based on empirical research studies. The former furnished a good background in general while the latter provided pertinent information which could be relevantly used in connection with this study.

Research studies that have described the introduction of automation into a number of manufacturing and office settings are as follows:

William Faunce studied automation in the automobile industry in a highly automated engine plant in Detroit, Michigan.[2] His purpose was to find and report on the effects of using automated machinery. The method employed was empirical, involving interviews with workers to compare the automated plant with older non-automated plants of the company. Pertinent problems covered changes in job content and the need for skilled technicians as well as increased need for preventive maintenance to assure efficient operation of the automated equipment.

Charles Walker examined automation in the steel industry which covered the Lorain Works of the National Tube Division of the United States Steel Corporation.[3] His purpose was to study and report on the transitional effects of changing from an old to a new semi-automatic steel pipe mill. The empirical method of interviewing affected employees was employed.

Problems similar to those of this thesis were, changes in wage rates and incentives as well as job content resulting from the job change contrast in the old as compared to the newly automated work.

Floyd Mann and Richard Hoffman's automation study of social change in power plants included the introduction of innovations for the periods between 1936 and 1951 in one of the 10 most modern and largest operations in the United States.[4] Pertinent problems studied via the questionnaire approach, covered

---

[2]William A. Faunce, "The Automobile Industry: A Case Study in Automation," Automation and Society, edited by Howard Boone Jacobson and Joseph S. Roucek (New York, 1959) pp. 44-53.

[3]Charles R. Walker, Toward the Automatic Factory, New Haven, 1957.

[4]Floyd C. Mann and Richard L. Hoffman, Automation and the Worker, New York, 1960.

resultant impact on jobs, employment and wage rates. Of particular interest were changes effected in job factors such as responsibility, skills and training.

Several monographs dealing with automation were published by the Bureau of Labor Statistics as follows:

Electronic equipment manufacture in the radio and television components was automated.[5] The purpose was to empirically examine by personal interviews of employees, implications of automating on jobs and earnings, wages and job content. Pertinent problems covered displacement of workers and skill requirements.

Automatic airline reservation system was introduced by one of the major companies.[6] Its purpose was to empirically survey by personal interviews with officials and staff of these organizations, the effects of change in automating office and service facilities on employment and occupations. Specifically related problems of changes in job content, requirements and skills were covered.

Petroleum refinery modernization was evaluated and its purpose was to empirically survey by personal interviews with officials and their organiza-

---

[5] Studies of Automatic Technology: _A Case Study of a Company Manufacturing Electronic Equipment_. Bureau of Labor Statistics, No. 1, 1955, pp. 10-12.

[6] Studies of Automatic Technology: _A Case Study of an Automatic Airline Reservation System_. Bureau of Labor Statistics, No. 137, 1958, pp. 13-15.

tion, the effects of technological change on job content and wage rates.[7] Pertinent problems covered planning for readjustments, displacement and reassignment and retraining of workers for major changes.

Note that the preceding review of pertinent literature has been brief at this time, essentially to introduce related scope to the subject of the writer's thesis in each respective case. The writer will present additional material where applicable, in the subsequent chapters of this thesis appropriate to the specific subject for greater effectiveness or significance.

Definitions. There apparently are as many definitions of automation or technological change as there are authors.

In order therefore to assure consistent understanding and feed back from all respondents associated with this questionnaire survey, the following definitions of automation accompanied each questionnaire (see Appendix I).

For the purpose of this thesis, automation can be defined - 1) Integration of machine, 2) linking machines together by means of automatic transfer devices, 3) mechanizing formerly manual or semi-automatic intermittent operations into a continuous process, 4) the use of tape and other automatic control devices to direct manufacturing operation of machines and machine systems using electronic or other components to regulate and coordinate the quantity and quality of production, 5) the use of devices which now do what

---

[7]Studies of Automatic Technology: A Case Study of a Modernized Petroleum Refinery. Bureau of Labor Statistics, No. 120, 1958, pp. 6-7.

men did before, 6) the substitution of machine power and control for human power and control. Some interchangeability of terms[8] will also be used throughout this thesis.

[8]For purposes of variation and overall coverage, the following terms will be used interchangeably as associated with the foregoing automation definitions:

technological change
advanced mechanization
automation
automaticity
automatization
automated work
automated machinery

Likewise, the interchangeable use of worker, employees, and operator, refers to the man or women performing the work or job. Henceforth, when reference is made to "the Company" this is to be interpreted as the Western Electric Company, Incorporated.

CHAPTER II

EFFECT ON EMPLOYMENT

The technological changes incorporated in the various shops surveyed in the Western Electric Co. had a number of effects on employment. Principally, workers were eliminated from old jobs, reassigned to other jobs and retrained. The number of workers, the type of employment involved and skill level, manner of handling employees affected and problems of retraining will be reported on in this chapter.

Reduction in Work Force. In individual studies of the Bureau of Labor Statistics, for example with an automatic airline reservation system, clerical tasks were eliminated during expanding business conditions.[1] Also, the BLS study of electronic equipment automation reported the work force was reduced by introducing new production techniques, "at a time of model change-over and of employment expansion."[2] In the modernized petroleum refinery study, it was reported that displaced production workers were reassigned to other jobs.[3]

As a consequence of the technological changes reported by the 47 respondents at the Western Electric Co., a total of 603 workers were displaced.

---

[1]Bureau of Labor Statistics Report No. 137, p. 11.

[2]Bureau of Labor Statistics Report No. 1, p. 10.

[3]Bureau of Labor Statistics Report No. 120, p. 6.

In securing followup feedback, no respondent replies were secured which indicated technical and supervisory personnel were actually involved in displacement resulting from technological change.

The composition of the displaced employees by skill level was as follows:

SKILLED 2%		
mechanics		5
metal workers		5
technicians		1
wood workers		4
	TOTAL	15 workers
SEMI-SKILLED 90%		
assemblers		207
adjusters		53
connectors		41
detailers		47
inspectors		25
quality checkers		37
testers		75
wirers		55
	TOTAL	540 workers
UNSKILLED 8%		
checkers		8
counters		7
handlers		10
helpers		8
packers		9
truckers		6
	TOTAL	48 workers

Analysis of the above data indicates the greatest degree of impact associated with the various technological changes (90 per cent) was on semi-skilled workers, (540 out of 603 were affected). Followup telephone interviews with respondents disclosed this category to be associated with the actual direct assembly and production of various types of telephone components and apparatus. Representatively, from two to as many as fifteen separate operations were integrated in the new methods of manufacture. Significantly then, an average of 4.81 operations combined per technological change should be noted as this shows generally, the impact per automation in the telephone manufacturing industry on employment; primarily, in the semi-skilled area of workers.

The second largest impact of technological change was on unskilled workers but, to a considerably lesser degree (only 48 out of 603 total workers displaced or 8 per cent). Followup telephone interviews with respondents indicated this worker category to be made up primarily of the auxiliary personnel indirectly related to the unautomated production operations. Supplying materials, checking, packing and taking away finished product into storerooms for subsequent delivery to the customer, were representative functions of these displaced workers.

The last and smallest impact of technological change was in the skilled area of workers (15 out of 603 total workers displaced or 2 per cent). Nine of these workers were associated with sheet metal forming and assembly and special wood working while the remaining six people were connected with maintaining machines or semi mechanizations, as reported by respondents from followup interviews. Workers having definite skills, needed to maintain and/or calibrate machines or testing equipment, were displaced accordingly; however, only to a very small extent.

<u>Disposition of Displaced Workers</u>. What happened to those who were displaced is of major interest. These excess workers required astute and effective handling form prompt reassignment. It was essential that they not only be utilized wherever possible but this was also necessary from the standpoint of preserving worker morale.

Questionnaire responses indicated that all of the 603 employees or from 33 to 50 per cent of the work force prior to advanced mechanization, were transferred to other work. There were no forced retirement or layoffs. These results were attributed to expanding business conditions either in existing product lines or introducing new products such as in the electronic component or electronic switching system fields. Company policy may have been a factor also, but economic conditions of the business were a primary influence.

There was equal work opportunity for the workers who were left on the existing jobs to be automated, as with those who were transferred to other work. It is interesting to report on how and in what way workers in both categories were treated.

Respondent replies indicated that 22 per cent of the displaced workers were referred to other shops for jobs in the same working capacities they had on the old job, e.g., hand assemblers were put on hand assembly work, testers were placed on check-out of finished sub assemblies, etc. Seventy-eight per cent of the displaced worker group were transferred to other work requiring retraining. This was necessary in order for workers to become acquainted with the nomenclature, configuartion or characteristics of the different product to be assembled, tested, adjusted, soldered or worked on in other ways.

Equally important, was the respondent overall report that the worker group left on the job to be automated, were retrained also. However, in this case, they were trained to operate, monitor, or tend advanced mechanizations and also to maintain the automated equipment. It should be noted again that at least 22 per cent of the employees transferred could be utilized in a similar worker capacity without re-training involved whereas, none could be directly employed on other automated work without some degree of re-training.

No response indicated instances of the company paying relocation allowances as an aid to displaced employees, primarily as transfers were effected within a plant. No out-of-town transfers were involved. Also, since there were no layoffs, no other employee-aid measures such as applying severence pay or arranging early retirements, were involved.

Procedure of transfer. An important area of worker preparation for displacement and training was brought out in respondent followup interviewing relating to securing more depth response in connection with the key question of this section. Apparently, the displaced workers had to be prepared in advance for what was to subsequently affect them which in turn had some bearing however intangible, on their later readiness for learning new work. It was therefore found from a majority of respondents that when an individual was selected for transfer from the old job to be automated, the following representative steps were taken by shop supervision in conjunction with the industrial relations organization.

1. He was told that equivalent employment or better was available.

2. He was told about when he would be making the change.

3. The man was tested for current aptitude and adaptability and this, together with his company service experience established his potential for re-training and re-employment.

4. Job openings were reviewed with the personnel organization by the men's supervisor and a re-training schedule worked out accordingly.

5. His date of transfer was set based on the technological change's culmination and the period of formal and on-the-job training scheduled.

6. Transfer effected.

Followup interviews with respondents indicated that properly handled displaced workers had better attitudes than those handled too informally which, influenced their progress in learning new jobs to a certain extent.

Retraining. The type of employment available for retraining displaced workers in contrast to their old assignment is listed representively as follows:

EMPLOYMENT

OLD	NEW
handler	loading & operating conveyor
assembler	assembling new product
sorter	component sub assembler
checker	quality control analyist
packer	production control records
inspector	maintenance of machines
stock keeper	computerized storeroom selector

Noted from respondent feedback interviews, were the cases in addition to the foregoing, of training workers to apply their past experience on different products. In this respect, the training covered familiarizing for example former assemblers to assemble the new product with its different characteristics. Examination of training programs indicated that there was less worker tension displayed in learning different work on the job as compared to formal classroom training. Respondent interviews indicated this true in 90 per cent of the cases where motor skills were required as compared to intellectual.

Limitations in learning and preparing for new employment, aside from worker aptitude and flexibility to adapt, were principally the age and sex of the workers. The following results from questionnaire response and telephone followup feedback indicates the most adaptable age and sex combination of worker application to technological change:

Question: "How well adapted were workers for learning the new jobs?"

	(A) Very good	(B) Average	(C) Poor
a. Older (55-60)			X
b. Middle (40-55)		X	
c. Under 40	X		
d. Women - long service			X
- short service	X		
e. Men - long service		X	
- short service		X	

In the A or "very good" category of adaptability, women particularly, under the age of 40 with short service in working were preferred along with technological change. Eighty per cent of the respondents contended the young women were less independent than men their age or older women and were anxious to please and establish a good work reputation due to short service.

In the B or "average" category of adaptibility, men in the 40-55 year age bracket were next in the degree of adaptability to technological change. Relative short or long service had apparently indicated no definite contrast to respondents in their experience. No specific reasons could be secured from the respondents to support or refute this category for middle aged men other than evident contrast of work performance under similar technological change conditions.

In the C or "poor" category of adaptability, older women (55-60 age bracket) with long service of 20 years or more were indicated by the respondents to be more questionable risks for learning, adapting and demonstrating quick or relatively prompt application to new methods of manufacture associated with technological change.

Two observations were secured with 66 per cent of the respondents questioned with respect to attempting some analysis in explanation of the "kind" of population in the "poor" category:

1. Women employees are usually not as plentiful in this age bracket primarily due to class A retirement, pension age coverage beginning at 55 (as compared to age 60 for men). Respondents found that occasionally, older women surprised the new operational supervisors by demonstrating good reliability and compatability but then, only after a considerably longer period on the new job.

2. Experience with the "poor" category of adaptability is in direct conflict with "seniority" preference advocated by the union. As is generally the case in the industry, the consistent employee security policy implemented by the company in agreement with union contracts, is to give older, longer service workers preference over younger and more readily adapted workers having less company service.

CHAPTER III

EFFECTS ON JOBS AND JOB CONTENT

Another important consideration associated with adjusting to technological change is its effect on jobs in general and on the job content of the individual workers in particular. We shall try to answer some questions such as, are some jobs eliminated by technology? are new jobs created? how do jobs change? What are the changes that take place in the job content?

<u>Effects on Jobs in General</u>. Before presenting empirical findings, it is appropriate to secure an overall perspective by reviewing some authoritative research in this area.

W. A. Faunce, Professor of Sociology and Anthropology at Michigan State University states;

> "Automation has changed job content on many jobs. The changes regarded as most important by workers in the automated plant were (1) a reduction in the amount of materials handling required, (2) decreasing control of work pace, (3) an increase in the amount of attention required by the job, and (4) a change in the type of skill required."[1]

F. C. Mann and L. R. Hoffman, Professors of Psychology at the University of Michigan found:

> "They reported that their present jobs were bigger in many ways than the ones they held in the older plants." — "their jobs required more training now than earlier", — "the use of present

[1] Jacobson and Roucek, p. 48.

skills and the development of new skills -- deserve attention."[2]

In addition they state,

> "One of the major changes which occurred in the new plant was that the men were generally given much more responsibility." -- "A similar but less strong relationship was also found from an examination of the groups which reported that their jobs are now much more interesting".[3]

C. R. Walker, Professor of Sociology at Yale University found in an automated steel mill,

> "In the last round there was general reinforcement of the conclusions of earlier interviews that jobs were easier physically, mentally harder than on the old mills."[4]

In the Bureau of Labor Statistics studies it was found, (in electronic equipment manufacturing) --

> "No greater skill or training seems to be required on the new jobs."[5]

(in a modern petroleum refinery) --

> "One of the most important changes over the past 8 years has been the raising of educational standards for both production and supervisory workers."[6]

---

[2] Mann and Hoffman, p. 73-74.

[3] Ibid., 83-84.

[4] Walker, p. 86.

[5] Bureau of Labor and Statistics Report, No. 1, p. 11.

[6] Bureau of Labor Statistics, Report No. 120, p. 7.

(in an automatic airline reservation system) --

> "The result of the change-over to the automatic reservation system in the content of jobs appears to be some reduction in strictly routine aspects" -- "These jobs require more experience, a higher degree of mental ability, and a preference for a variety of duties."[7]

J. R. Bright, Professor of Business Administration at Harvard University studied the effects of mechanization on 13 plants employing almost 50,000 people and the result of his research shows the correlation between the degree of mechanization and the changes that took place on the resulting skill of operators and job demand. He states:

> "Automated machinery requires less operator skill, or at least not any more skill, after certain levels of mechanization are passed."[8]

<u>Elimination of Old and Creation of New Jobs</u>. This study shows that 63% of the respondents claim recent technological changes at Western Electric Company affected some jobs. This high degree of job changes affected in the Company was further verified by telephone contacts and feedback and certainly the result obtained from the next survey question confirms this.

"What Jobs were Eliminated?" A general listing of the jobs and associated functions eliminated due to technological change is better illustrated using the respondents' terminology. This is as follows:

"principally manual labor"
"manual handling"
"manual loading"

---

[7]Bureau of Labor Statistics, Report No. 137, p. 13-14.

[8]James R. Bright, <u>Automation and Management</u> (Boston 1958), p. 176.

Followup telephone interviewing of respondents permitted a more detailed breakdown of the preceding findings.

Jobs Eliminated	Associated Function	Frequency of Elimination
Parts assembler	manual operation	16%
Handler	utility work	14%
Parts Inspector	visual inspection	7%
Parts shaper	trimming operation	6%
Stock keeper	handling	5%
Bench checker	manual sorting	5%
Component loader	manual feeding	4%
Machine operator	insertion	4%
Mill helper	rod rolling	2%
	TOTAL	63%

An analysis of the foregoing data shows that manual assembling and materials handling jobs associated with production operations experienced a high degree of reduction or were eliminated by the technological changes. The frequency in which jobs were eliminated as shown above in respective percentages, is intended to be representative in the overall.

Job Elimination Example. The preceding detailed accounting of representative jobs removed from the old manufacturing operation leaves the question of how this generally came about, or how do jobs change? It is appropriate to record the benefit of actual respondent feedbacks in this respect by presenting a pertinent discussion of jobs being eliminated.

The elimination of many jobs such as those previously itemized, was made possible by combining them and substituting machine control in their place. For example (per individual respondent description),

> "The manual sorting and feeding jobs were eliminated by developing and using a vibrating bowl arrangement. The parts were dumped into the bowl and they were automatically vibrated into proper position. Oversize or undersize parts were not accepted, (could not fit the orienting member escapement arrangement in the bowl), hence, only good parts were sorted out and used with questionable parts dropping back and remaining in the bowl to be removed before the next bowl loading. The acceptable parts were then automatically fed down a track to the point of machining."

A significant feature in the above example which is typical of many advanced mechanizations, covers elimination of the human inspection function formerly required to control parts quality in the previous manufacturing phase. Machines have the consistent discriminating characteristic of being able to perform efficiently with acceptable quality parts only. The operative tolerances and dimensions of their working components, are designed to function as a "built-in" monitoring feature and they can therefore work only with quality parts. Respondent experience indicated that this "bonus" feature is often overlooked by engineers and operating people alike who have initially at least, blamed the machine rather than poor product parts quality for automation, malfunctioning and resulting production inefficiencies.

The accepted phenomenon of creating jobs by technological change is illustrated in specific terms by the respondents' answers that at least 60% of the jobs which had been added by advanced mechanizations were composed of the following,

machine tender
machine monitor
machine setter
layout operator
special mechanical maintenance
machine maintenance
mechanical/electrical troubleshooter
special mechanical adjuster
tool maintenance man

The above jobs may be divided into two categories:

1. Newly created production and maintenance jobs.
2. Changed production and maintenance jobs.

1. Newly created production and maintenance jobs were those not previously established anywhere in the Company.

In the case of production jobs, these were reported to be of the machine tender and machine monitoring type which were made possible with the development of multi-station manufacturing machinery. Because they are completely new, the writer feels it appropriate to discuss them in detail.

It was found that the machine tender and monitor's jobs varied in complexity dependent on the level of automaticity, e.g., the less automated jobs required closer and more constant machine tender attention whereas in highly automated work, the work pace was controlled by the machine and the machine tender's job became less complex.

A typical machine tender's job tour of duties is summarized per overall respondent experience as follows.

> "Responsibility for keeping parts hoppers filled; cleaning, lubricating and adjusting machine; observing 5 transfer stations to assure proper operation; When machine stops, checking each of 5 stations quickly and efficiently for malfunctions due to:
>
> jamming, mis-feeding, poor parts quality, poor

> machine adjustment, worn machine components, broken machine member, blown fuse, dirty machine condition, and need for lubrication.
>
> Call mechanical or electrical maintenance man promptly if corrective measures taken by operator do not solve malfunction; allowance to make expected hourly output of 7,500 parts is 2 jams per 1000 parts manufactured."

It was observed and verified with most of the respondents that where fewer motions were required on the part of the monitor to produce the expected output, the mechanization took over or controlled the pace of work to a large extent.

Where more of the above operations were covered by the machine tender, a larger degree of observation, attention, alertness and diagnostic effort was personally required. These of course, influenced overall productivity and the extent that the tender could control his job.

In the case of maintenance jobs associated with mechanizations, these were reported to be of the special mechanical maintenance, mechanical/electrical trouble shooter and special mechanical adjuster type. It was difficult to separate and define exact duties between these jobs; however, a typical detailed maintenance instruction secured as a result of the writer's on-the-job mechanization experience can be seen in Appendix II. This covers a multitude of maintenance requirements where these jobs were applied in one form or another and varying in nature from one job to another.

2. Changed production and maintenance jobs were those which were added to the Western payroll but which had not the same composition as before elsewhere in the Company.

In the case of production jobs, these were reported to be of the layout operator and machine setup type which were readily applied to many of the advanced mechanizations. They were particularly suited to fill the need for planning material selection and product ordering needs for production runs; also, readying the mechanizations for dependable production runs per each shift of operation.

In the case of maintenance jobs, these were reported to be of the machine maintenance and tool maintenance type which were primarily used to help keep various mechanizations running and in top operating order.

Several related aspects were found which can be used appropriately to summarize this section. Of all the kinds of jobs added, machine tending, production setup and special mechanical adjusters were found to be in highest demand.

Also there were the jobs in short supply for at least the first year after the technological change. These were largely machine maintenance, production setup and machine tender types. The most obvious job shortage was in the area of machine maintenance. The highly complex mechanizations together with their extended use in many manufacturing operations of the company, required skilled maintenance support help to keep them running efficiently. The length of time required to secure and train this type of personnel, definitely contributed to the major shortage in this respect.

Setup men were also in demand altho, to a lesser extent. In many technological changes, a roving utility man was delegated to perform minor maintenance functions of adjustment and component replacement in addition to his setup duties. Only when specific work of a repair, overhaul or major replacement nature was required, were more knowledgeable machine maintenance personnel called by the setup man.

Changes in Job Content. Automation affected existing jobs and therefore changed the job content. But, before proceeding with data presentation and discussion, it is necessary to list most of the associated overall job factors that are concerned in the company. Then, we can proceed to show how various of these factors were influenced by technological change.

JOB DEMANDS CHART*

Requirements	Conditions	Responsibilities
Strength	heat	problem solving
coordination	cold	raw material
comprehension	physical labor	equipment
initiative	mental activity	product & quality
judgement	hazards	shut down
stability	noise-dirt	meeting schedules
education	production activity	coordinating job
experience	inherent difficulties	work pace
capacity	type of work	safety

By the nature of this empirical study, it was not possible to cover every item in the above listing individually. This was due primarily, to the variety of technological changes surveyed. The above summary of job demands was helpful, however, as an interpretative reference guide in follow-up interviews to secure additional depth response from the survey participants where required.

To facilitate planned reference throughout the remainder of this thesis,

*Summary of company job evaluation factors record.

levels of automaticity covered in the questionnaire (See Appendix I, page 91, question #6) are restated here as follows.

<u>Levels</u>

a) Machine actuated by introduction of materials or parts or work piece.

b) Machine processes and reports status of action or characteristic of product.

c) Machine signals as well as records.

d) Machine modifies its own actions.

e) Complete automation.

<u>Job Requirements</u>. The skill factor is a function of various requirements shown on the job demand chart. With the various technological changes culminated, human controls and operations previously required, were replaced with automatic controls and mechanisms which definitely affected the job content. More specifically, two-thirds (66 per cent) of the respondents reported that there was a change in skill as various job requirements had changed. The various requirements were increased or decreased with the level of automaticity specifically applied per technological change. In thirty-eight per cent of the jobs, skills had been upgraded. In this group, electrical, hydraulic and pnuematic maintenance skill needs increased for servicing practically all levels of introduced automaticity. They rose higher as the level of automaticity progressed starting from <u>c</u> through <u>e</u> and were significantly higher in the top two levels (<u>d</u> and <u>e</u>). The job requirements of comprehension, initiative, judgement, and capability were higher thereby influencing skill levels upward on maintenance jobs accordingly. The preceding trend in skills applied to machine repairmen as well since this

work required closer and more constant attention also.

An interesting contrast in skill change was verified also in followup interview with respondents concerning mechanical operator skill. This was associated with keeping equipment running efficiently in respect to tender and monitor jobs. This skill increased with the a and b levels of automaticity as more comprehension, judgement and capability were demanded. However, as the mechanizations became more advanced (from automaticity levels c through e) the work pace and actual productive process were controlled by the automation to a greater extent, rather than by the tender. This changed operating condition affected the previously listed job demand requirements and the associated skill level was accordingly reduced.

The preceding trend of skills changing downward, was part of the 28 per cent of setup jobs shown to be in scarce supply. Loading and inspection skills also decreased in connection with the b level of automaticity as related job demand requirements diminished.

Respondents reported that 32 per cent of the jobs where the mechanization was actuated by the introduction of materials or parts or a work piece, required more manual dexterity than with the higher levels of automaticity. More coordination where parts were manually fed was needed including the frequency of prompt adjustment using electrical, hydraulic and pneumatic machine maintenance skills in this respect. The latter was representative of the less automated machines.

Also, manipulative skill and dexterity changed in 47 per cent of the advance mechanizations. Human control, particularly in coordinating the manufacturing process, necessitated a high degree of accuracy as product quality would have suffered. On the other hand, with jobs associated with the higher levels of automaticity (b through e), improved job accuracy, better control of product quality and greater diagnostic effort were not required of the tender for the same reasons applicable to dexterity.

Education as a job requirement varies in necessity depending on the level of automaticity and specific characteristics of a technological change. The calibre of available personnel, previous knowledge, on the job training, and formal class study on related subjects, also were indicators of whether education is required and its extent. Respondents indicated that in 35 per cent of the mechanizations, education was a factor in learning the new or changed job. The worker had to understand its operation, its control, its adjustment, and proper maintenance of the mechanization in the less advanced installations (a and b levels of automaticity). When power was applied to manufacturing equipment and as regulatory devices requiring careful adjustment to obtain proper production application were provided and increased in complexity, the worker was required to learn more about the mechanization, hence needed additional training.

On the other hand, 65 per cent of the jobs as reported by respondents, required no further education beyond the high school level. This does not infer that 35 per cent of the jobs did require more education. A representative breakdown of employee education background is shown later. The 65 per cent was true in many areas of operation of technological changes having levels of automaticity c through e except as will be discussed directly with respect to educational levels. Supportive reasoning secured from respondents was readily understandable. When a pattern of predetermined productive mechanization was mechanically achieved, there was less need for the understanding, the training, and further education of the worker as was required when machinery adjustment and control lay in his hands.

It is important to note that the degree and extent of job complexity changes can vary from one mechanization to another, e.g., the jam frequency associated with a specific mechanization can demand considerably more initiative or operator capability than a mechanization where this correction is made automatically. The higher level of automaticity in some technological changes, requires a greater need for educational background and understanding. In some mechanizations, the need for educational background and understanding of principles appeared to continue well into the higher levels of automaticity as job demands dictated, e.g., where the mechanization had a specific hydraulic parts feeding characteristic, the operator was required to have some education and resulting understanding in correcting hydraulic problems.

Respondent experience indicated the following representative educational background of workers employed in technological changes:

	Employee Population (%)
Grammar school education	32
Two years high school	34
Four years high school	37
Two years college	7
Four years college	0
	100 per cent

The amount of education and mental demands required by the various jobs, were not reported in the followup interviews as having a definite relevant relationship. However, the majority of technicians and special machine attendants and maintenance personnel had two years college or four years high school education as a part of the percentages listed on the preceding page. Mechanical adjusters, utility men, some layout operators and mechanical/electrical trouble shooting jobs required the people representatively that had grammar school and two years high school educations.

The most interesting findings associated with educational aspects, were secured from the survey question, "What kind of education helped the worker learn the changed job demands?"

In-plant technical courses coupled with on the job instruction varying in duration from 3 to 6 months proved the most useful for machine tender, setup and tool maintenance work. Practical theory background, classroom work of 6 months duration followed by on-the-job applicational training in hydraulic, pneumatic and electronic principles directed toward mechanizations, proved more desirable for training special mechanical maintenance personnel. Formal evening school study at the junior college or university level while aiding the men's potential to grow and advance, was not directly useful as a preparation medium to operate automations.

The respondents indicated that on-the-job training was the most valuable training medium coupled with initial classroom training periods. This applied to the same 35 per cent of the respondents where education had been indicated as important in learning the new or changed job.

Last to be surveyed in the job requirement section of the job demand chart, was the experience factor. This was found to be a minimal factor as the level of automaticity increased. Thirty-four per cent of the jobs required an experience level not exceeding 3 months on related work as pre-training was stressed to attend levels of automaticity ranging from complete automation to mechanizations which modify their own actions (levels e and d). Twenty-four per cent of the jobs were indicated by respondents as requiring at least 3 months but not over one year experience on automations where the mechanization signaled as well as recorded product quality variations (level c). Note that the experience level need becomes greater as the level of automaticity decreases. Further confirmation of the observation was made when respondents indicated that 34 per cent of the jobs involving automaticity, where the mechanization processing and reporting the status of production (level b) required an experience level of over one year but not exceeding 3 years. The longest experience interval required to perform the newly added job was over three years but not exceeding five years. This was representative of only 8 per cent of the jobs where the mechanization was actuated by the introduction of materials or parts or a work piece. Mechanical skill in maintaining these kind of technological changes required the long interval of experience in order to gain the necessary proficiency.

Experience then, is necessary with technological change, but certainly this is not as important as the preceding factors discussed.

A significant overall analysis of respondent feedback and reporting was made available from the survey question, "What kind of experience was required in the jobs created or changed by Automation?"

Representative Type of Experience	Representative Job Involved	*Frequency of occurance in the overall
mechanical experience with machinery operation	machine tender and/or monitor	20%
ability to analyze malfunctions of and adjust machines	special mechanical adjuster	20%
Mechanical trades work	machine setter	15%
Tool making	tool maintenance man	15%
Blue print reading	layout operator	10%
Manual dexterity and knowledge of shop operating requirements	special mechanical maintenance	10%
Toolroom or machine shop experience	machine maintenance	5%
Electrical and mechanical mechanism adjusting	mechanical/electrical troubleshooter	5%

*Covers the overall experience demand for technological changes of automaticity levels a through e.

Working Conditions. Aside from the various job requirements discussed above, job conditions also have varying effects on job content. The job demand chart lists heat, cold, physical labor, mental activity, hazards, noise-dirt, production activity, and inherent difficulties which can be associated with the work to affect jobs positively or negatively. This section will explore the impact of some of these conditions on jobs where respondent reports and resulting material could be correlated to provide noticeably significant results.

The survey question, "Does the new work have more variety?", secured a 68 per cent positive answer from the respondents. Supporting representative information showed more abundant variety inherent with machine monitoring and machine setting work. The job challenge appeared to be greater in this respect.

It was found that technological change, had a greater multiplicity of productive operations and therefore, gave the workers a greater variety in their duties. Respondents also reported that automated jobs required closer and more constant attention particularly in the lower levels of automaticity. On the other hand, no variety was reported by 32 per cent of the respondents in connection with newly automated work under specific conditions. This substantiated our previous finding. Variety was found lacking in work where the pace and operations were controlled by the mechanization rather than the tender particularly with the higher levels of automaticity.

A cross validity to the above finding was obtained by the question, "Compared to the old job, is the work more or less monotonous?"

Sixty-eight per cent of the respondents indicated that the automated jobs were less monotonous and they based their contention on the following representative experience;

a) machine tending requires alertness particularly in the lower levels of automaticity.

b) Continuous surveillance is required.

c) Workers associated with automated work have more opportunity to move around.

d) Variation in operating and controlling mechanizations.

e) Variation of the mechanized operations.

A further substantiation was obtained when 68 per cent of the respondents confirmed the statement, "the new operation is not routine". Similar reasons as those previously mentioned were given.

The evidence, in gathering other material for this study, suggested a reduction in physical demand or effort required with new jobs associated specifically with higher levels of automaticity. This was confirmed by a majority of the respondents in answering a number of questions as follows:

1. Sixty-six per cent of the new or changed jobs required little or no lifting effort, 19 per cent required only occasional lifting effort from 2 to 10 per cent of the productive time, and only 15 per cent of all jobs required some lifting effort up to 50 per cent of the time.

2. Seventy-two per cent of the new or changed jobs required light work involving little physical effort, 19 per cent required some lifting over one pound and up to five pounds, and only 9 per cent of all jobs required some lifting from 5 pounds but not over twenty-five pounds.

3. Supportive reasoning secured from respondents with respect to minimum physical effort was that, it was almost eliminated in the upper levels of automaticity and considerably little even with the lower levels of mechanization. Such representative respondent comments as, "Machine does the work", "less parts to handle", "complete machine control", and "less effort in the overall", substantiated the findings concerning this job factor.

The inverse result of the latter job factor findings was disclosed in studying the effects of the mental demand factor on new or changed jobs. "Greater mental problem solving and diagnosis of mechanization operations than physical effort", was the concensus of respondent experience.

Substantiating data reflected that 38 per cent of the jobs had work which required frequent mental activity on the operators part, 47 per cent required continuous mental attention and 15 per cent of the jobs had work which required a high degree of concentrated attention. The highest degree of automaticity required the least mental demand in the overall.

Initiative and ingenuity levels reflected similar trends related to automaticity. Thirty-seven per cent of the jobs required a high degree of ability to understand and work unaided, associated with the lower levels of mechanization. Forty per cent required the ability along with general instruction to work under minimum direction in the high levels of automaticity.

The job hazard factor was verified as minimal with technological change, as proper guarding of machinery was employed. Therefore, 45 per cent of the jobs were reported by respondents as having conditions where accidents or hazards to health were negligible and 50 per cent had only minor skin irritant conditions inherent in the job. Protective procedures such as special clothing and gloves were employed in these cases.

The last job condition of noise and dirt surveyed, was also minimal in affecting new or changed jobs. Good shop conditions and clean work was indicated to be representative in 38 per cent of the technological changes and, 54 per cent where the work involved some dirt, oil, grease, or noise but did not disturb the physical or mental well being of the employee.

Job Responsibility. With respect to new and changed jobs, the last major job demand factor of responsibility will be reviewed. The impact of changing responsibilities resulting from changed job content associated with technological improvements, is to be considered in determining how jobs are affected. Of the representative responsibilities listed in the job demand chart, the operator's accountability for problem solving, raw material, production equipment, product and quality, shut-down, coordinating job, and safety were specifically found in evidence.

In the survey question asking which phase of the job presented constantly new problems to the operator, drew specific illustrative replies from respondents rather than categorical ones which would have been expected, e.g., continuous surveillance is required to diagnose changing machine operating problems in the piece part stage. The replies were typically as follows:

"attaining greater output"
"correcting machine malfunctions"
"diagnosing machine difficulties"
"making machine run"

The relative degree of responsibility for raw material required of the operator to avoid waste or loss was also interesting. This was covered by the following survey question and findings.

"Work in which the failure to exercise proper care could reasonably result in a loss not to exceed":

$10	22%
$10 but seldom $100	38%
$100 but seldom $250	18%
$250 but seldom $500	9%
$500	13%
TOTAL	100%

It is apparent that material wastage was not a major factor affecting the operator's job classification level, as workers were seldom found to exceed the limits in any one of the preceding categories. The mechanizations controlled product quality quite well for the most part.

The degree of which the operator's responsibility increased with the new jobs was logical, in comparing cost accountability of the equipment or process to the raw material aspects previously discussed. This can be illustrated by presenting the survey question and results secured from respondents.

Degree of responsibility for equipment or process required to perform the newly added occupation of the highest level:

a.	Work in which there is no probability of damage to equipment or process, or work in which the failure to exercise proper care could result in a loss not to exceed \$5.00	8%
b.	Work in which the failure to exercise proper care could reasonably cause damage that would exceed \$5.00 but seldom \$25.00	19%
c.	Work in which the failure to exercise proper care could reasonably cause damage that would exceed \$25.00 but seldom \$250.00	45%
d.	Work in which the failure to exercise proper care could reasonably cause damage that would exceed \$250.00 but seldom exceed \$1,000.	28%
e.	Work in which the failure to exercise proper care could reasonably cause damage that would exceed \$1,000.	--

Follow up interviews with respondents indicated a significant relationship in increased responsibility, comparing the old job with the new or changed jobs in this respect. In most cases, there was about 1/3 increase per operator in the amount of raw material handled and equipment or process accountability on the new or changed work, over the old job.

Two reasons were found to support the experience of respondents contending greater responsibility per operator being characteristic of the technological changes surveyed.

1. There were generally less employees per dollar of product manufactured.

2. In combining various steps of production, more operations came under the control and hence, were essentially performed per operator.

Another measure of responsibility, although somewhat less reliable, was secured by the survey question,

"With the technological change, has the money value of the manufacturing equipment changed?"

Ninety-six per cent of the respondents had experienced that responsibility had increased per operator. However, a certain number of respondents were doubtful whether this was a good measure if at all, of increased machine tender responsibility, e.g., a more costly mechanization per square foot of space, did not necessarily increase the employee's accountability by requiring greater skill, alertness or diagnostic effort of the operator etc.

Direct confirmation was secured of a previous supposition that mechanizations controlled product quality well. Seventy-four per cent of the respondents contended that it was harder for the machine tender to make an error in manufacturing the product by the automated method. This was on the basis that the machine controlled the operation and quality of the product in the higher levels of automaticity.

On the other hand, 56 per cent of the respondents indicated it was easier to make an error in the lower levels of automaticity due to such typical reasons as,

"machine requires careful handling"
"a complex setup is required"
"more operations and decisions are involved"
"if controls are malfunctioning, visual observation may lag and not be effective"

The degree of nonsupervisory responsibility for instructing and coordinating and maintaining the flow of work was negligible. This was found true in 44 per cent of the technological changes where the level of automaticity was high and complete control of the production process was afforded by the mechanization. In the lower levels of automaticity where there was still some kind of work group condition, 50 per cent partial responsibility was indicated by the respondents for a machine tender instructing or directing designated people. The duty of a "lead man", usually characteristic with bench assembly work on the old jobs, was therefore substantially eliminated with technological change as described above.

Further confirmation of greater machine control over human control in connection with high levels of advanced mechanization was secured. Eighty-two per cent of the respondents indicated that the employee was accountable for less responsibility for the safety of others with respect to highly automated level of machine tending jobs in this respect. The remaining 18 per cent reported that a certain amount of reasonable care was required by the operator in order to avoid injury to others of a serious nature, e.g., this would be exemplified by hot parts from annealing furnaces or hazardous production processes involving toxic cleaning vapors or moving machine components. Improved safety was the conclusive finding.

As a followup check of overall operator responsibility inherent with technological change, the following survey question and resulting answer confirmed much which has been discussed in this section of the chapter.

> "To what degree is the operator personally accountable for the newly automated operation?"

Fifty-four per cent of the respondents contended technological changes required some machine tender accountability to the extent that the worker must cope with machine capability, e.g., running problems and jamups etc. Also, he must be personally responsible for detection of faulty production operations where built-in inspection devices were not a part of the mechanization. Overloads, malfunctions, parts shortages, changing materials, and meeting schedules were inherently involved with many of the lower levels of automaticity as characterized per specific technological change. The high levels of automaticity therefore, were not concerned with operator personal accountability to any large extent.

CHAPTER IV

WAGE RATES

As discussed in the last chapter, the way in which jobs were organized with the technological change necessitated the reshuffling of workers according to the needs of the business; which, in turn had some affects on wages. It is one of Western Electric's policies to pay workers equitably for services rendered and the transition from manual effort to partial or various higher levels of machine control, influenced various aspects of wages. In this chapter, the effect of technological change on absolute and relative wages and methods of payment will be examined.

Before doing so, it is appropriate to survey in brief, the findings of other studies to present a perspective with which to establish general means of comparison.

Faunce disclosed that,

> "Automation did not have any appreciable effect upon the wage structure in this plant. In automated departments, a larger proportion of the workers were given job classifications with higher hourly wage rates and higher rates for some machine operator jobs were negotiated but no major wages changes were made".[1]

[1] Jacobson and Roucek, p. 46

Mann & Hoffman contended that the automated work,

> "required more knowledge and responsibility on the part of the nonsupervisory workers",

which in turn contributed to a higher job grade structure. As a result, they further report that,

> "Operations at advance (the automated plant) required that a higher proportion of its operators have the top job grade", (infering higher wages for more workers).[2]

Walker found with the established automation that,

> "incentive was at a maximum, rising at times to 35 and 40 per cent above base pay".[3]

Also he observed,

> "the men were paid enough more in their individual rates so as not to be penalized for the time the mill was down due to no fault of their own".[4]

The Bureau of Labor Statistics study of a Modernized Petroleum Refinery disclosed,

> "Production workers in this continuous process plant receive relatively high wage rates, compared with factory workers generally".[5]

The Bureau of Labor Statistics study of a Company Manufacturing Electronic Equipment reported,

> "Pay rates for the automation jobs were set at 5 to 15 per

---

[2]Mann and Hoffman, p. 27.

[3]Walker, p. 163.

[4]Ibid, p. 165.

[5]Report No. 120, p. 7.

> cent above the straight time hourly rates for unskilled assemblers because of some differences in working conditions and increased responsibility".[6]

There are many factors which if present, can influence wage rates up, down or to remain the same. Evidently, there were different job and work conditions in the automobile industry than in the steel industry for example, which did not influence any major wage changes on one hand but permitted however, more workers to hold higher paid jobs on the other hand.

Effect on Absolute Wage Levels. With these references to other studies, let us see what the impact of technological change was on wage levels at the Western Electric Company.

Sixty-seven per cent of the respondents reported technological change increasing the level of worker wages as against only 27 per cent of the advanced mechanizations which had no perceptible effect on wage levels. This impact to influence the upward trend of wage rates was validated within 4 per cent by agreement of the majority of the respondents with the survey statement that technological change,

> "Creates some jobs with attractive pay scales".

Most (71 per cent) of the respondents agreed with this statement.

Analyzing these findings, it was disclosed that wage rates increased as a result of higher job requirements and responsibilities connected with technological change. Representative jobs and hourly pay ranges before and

---

[6]Report No. 1, p. 11.

after automating where applicable, are listed.

	Wages Prior	Wages After	Increase differential per hour
Layout operator	\$2.00 to \$2.13	\$2.13 to \$2.32	\$0.19
Machine tender	New	2.32 to 2.52	--
Machine operator	New	2.52 to 2.71	--
Machine setter	2.32 to 2.52	2.52 to 2.71	\$0.19
Special maintenance	New	3.45 to 3.65	--

These attractive pay scales were in the production, (layout operator, machine tender and machine operator) as well as the maintenance, (machine setter and special maintenance man) phases of technological change where a skill differential was maintained per job.

While not new, it is interesting to note conformity with established situations for instance, on how much higher the wage level is for the more highly skilled maintenance jobs than for the less skilled production type jobs. Respondent feedback further disclosed an interesting point, that the wage rate levels paid per job range shown above, varied inversely to the level of automaticity controlled, e.g., production work controlled by machine tenders on somewhat less automated mechanizations were paid at the upper range of their grade whereas wages at the lower range were paid due to lesser skill demand on highly automated work. Other respondents reported, in some cases machine operators were used only on the lower level mechanizations where more demanding job requirements and responsibilities were present. Machine tenders were only used on upper levels of automaticity.

In the maintenance area, the wage rate levels paid per job range varied somewhat in direct proportion to the level of automaticity serviced, e.g., maintenance work associated with the lower levels of automaticity was serviced by lower paid machine setters as compared to special maintenance men servicing the more complex automations.

A related aspect of establishing absolute wage levels is the application of temporary payment coverage during the initial stages of introducing technological change. Workers had to be trained on the job and familiarized with the newly created jobs to assure effective and efficient control of each automated process. They also had to be suitably compensated in the interim of gaining job performance capability.

Most (65 per cent) of the newly created or changed jobs had some form of temporary payment coverage during the operator training period as reported by respondents. This generally lasted from one month to one year or an average of five months depending on the specific job and its relationship to the automaticity level concerned. The remaining (35 per cent) area of temporary payment comprised the prove-in period of automation, e.g., the interval required to eliminate or reduce the bugs from a new mechanization to the point of minimum machine down time and realizing the expected hourly output thus permitting the operator or tender to make good earnings.

Frequently, effective temporary payment was the stepping stone to successful new job establishment with a minimum of labor and morale problems, as reported in telephone followup interviews with respondents.

Wage Relationships. Satisfactory relationships were indicated by respondents to be representatively present between the earnings on former jobs and the wage levels associated with jobs connected with technological change. Equitable pay relationships were experienced in most (74 per cent) cases of technological change. The transition from the earnings made on former work to the changed or new job rate levels connected with automated work, was realized satisfactorily with the application of temporary payment plans. Effective use of temporary payment plans allowed a smooth unhurried transition to the establishment of equitable wage payment plans, e.g., introducing an interim wage rate which produced the desired intent of compensating new workers who were learning the new or changed jobs or were required to control an unproven mechanization. Under these circumstances, temporary payment usually included fair value of the specific work skills involved compared to established standards of pay for similar work elsewhere in the company, according to followup interviews with respondents. In some cases, a 15 per cent increment was added to a base rate established in the manner described above; however, this was found to vary from one automation to another and definite guide lines and wage differentials in quantitative terms were therefore difficult if not impractical to representatively secure in view of the multiplicity of technological changes involved. Significantly, in no case surveyed was it found that workers lost money on the new work, as they were not paid a lower wage rate than they had been making on previous work or, were they penalized due to breakdowns, delays or otherwise uncontrollable machine stoppages associated with unproven advanced mechanizations.

At any rate, as a result of temporary payment, an adequate interval (usually from 3 to 6 months) of job evaluation and time study afforded establishing realistic permanent payment commensurate with the actual degree of mechanization control and service duties required to be performed on each specifically debugged automation. This factual and practical manner of determining wages after proving in technological change, contributed in a large measure, toward worker satisfaction and morale.

Evidence of satisfactory earnings among automated jobs was indicated by respondents in representative comments.

> "job grading plan compensated well leading to apparent job satisfaction and contented employee"

> "pay relationships were adequate from most worker comments heard and morale noted"

> "Rates were set equitably"

> "People were anxious to get on the jobs associated with the newly automated work"

> "Operators were enthused over work and wages paid"

Further validity of the preceding findings was secured by a 95 per cent negative response to a related survey question.

> "Was there any change in traditional wage differentials on the automated jobs with respect to those which have had long standing acceptance?"

The reply and feedback from respondents, indicated that the grades and wage differentials on the new jobs were consistent with those of long standing acceptance on other jobs.

Still further validity was presented where a large segment (58 per cent) of respondents agreed that technological change tends to maintain satisfactory relationships between the earnings on each job and advancing workers within rate ranges, e.g., respondents emphasized in followup interviews that similar fulfillment of pay commensurate with job control and services rendered by the workers was evidenced from their experience, as compared to former jobs. Further respondent feedback disclosed that the standard hourly structure for workers on old jobs was used and applied to workers on the new and changed jobs. This is shown in the following.

Representative Job Grade Hourly Rate Structure
(applied throughout the Company on all manufacturing shop work)

Production Work

Incentive Payment

Grade	Start. Rate	Job Rate
32	$2.00	$2.13
33	2.16	2.32
34	2.33	2.52
35	2.50	2.71
36	2.66	2.90
37	2.81	3.08
38	2.96	3.26
39	3.13	3.45
40	3.31	3.65
41	3.49	3.85

Maintenance Work

Time Payment

	Start. Rate.	Job Rate
"C"	$2.97	$3.24
"B"	3.24	3.66
"A"	3.57	4.11

Incentive Payment

Trades Group 2

Starting Rate:	$3.05
Control Rate:	3.76
Trade Rate:	4.11

A small (26 per cent) but noticeable segment of respondents indicated some doubt as to whether all technological changes promoted equitable pay relationships among automated jobs. Also, there were a noticeable (38 per cent) number of respondents which were undecided about automated work tending to maintain satisfactory relationships between the earnings on each job and advancing workers within rate ranges. Telephone interviews secured supporting depth response in respect to reflecting some difficulty with established methods of job evaluation to accurately price automated work such as machine tending. It was contended that since automated work became less quantitatively measurable, workers did not always feel they were equitably paid due to application of standard job descriptions to the new work. For example, employees were noted to view their automated jobs as requiring increased responsibility, simply because the mechanization was large and it cost considerably more than any machine they had ever been associated with before.

There apparently was some tangible experience however, to better support the preceding comments. Respondents contended that with respect to various types of technological change and the higher levels of automaticity,

1. Operators did not control quantity and quality of product being manufactured.

2. Operators made few if any production operation decisions.

3. They exerted less physical and in some cases, mental effort, dependent on the level of automaticity, etc.

4. Operators required less skill, education and experience where the machine paced the work.

It would appear therefore in some cases, that a different criteria for wages be used and a job evaluation tailor-made aside from established methods, to more equitably cover the machine tender type of job associated with technological change.

Method of Payment. In general, the varied nature of the many technological changes surveyed and also, the different levels of automaticity involved became more evident as corresponding differences of payment for product manufactured, were disclosed. For example, 74 per cent of the respondents indicated technological changes to have time payment involved. On the other hand, the smaller group (26 per cent) of respondents employed some manner of incentive payment. Various aspects of these plans will be covered in detail later.

A significant aspect of the methods of payment employed, was the manner of introductory compensation used in temporary or initial payment of workers during the learning and/or prove-in stage associated with the new or changed jobs. This study disclosed four categories of introductory payment.

1. Average earnings was paid the new workers what they would normally be making after more experience and having gained reasonable proficiency on the job. In many cases the new employees realized higher earnings than on the final incentive payment plan put into effect.

2. Management allowance paid the workers a set amount per week regardless of their output or the product quality produced. This was generally done with the employees well being in mind and in line with respondent experience indicating it to be satisfactory and equitable as a lead into a permanent incentive rate.

3. Limited rate payment of workers included some equitable amount per output; for example, for the first three months of initial or prove-in mechanization operation. This could be reasonably revised for the subsequent three month period dependent on the automation and employee proficiency gained and continued until the final changes to the mechanization were completed and a permanent payment plan accepted.

4. Day work paid the workers a starting amount per hour regardless of their output or the product quality produced. This was similar to time payment however it was generally at a lower rate than permanent time payment plan coverage. The objective as with the other introductory payment plans, was to pay the learner equitably and also compliment him for effort expended with no direct relation to actual effectiveness.

Of the four introductory payment approaches used in various of the Company plants and in various levels of automaticity, the "average earnings" and "limited rate" methods of payment were the most popular. The manufacturing engineer preferred the limited rate payment approach as this could be used aggressively to guide, control or inspire the operating shop towards a somewhat more progressive and realistic transition to the permanent wage payment plan ultimately adopted. e.g., payment allowance for a high rate of machine stoppages could be improved with gained proficiency to a much lower figure commensurate with improved operation of the mechanization.

On the other hand, the manufacturing shop organization in charge of operating the automation, prefered the average earnings payment approach as there was no chance of being penalized for below normal or less than expected introductory output. On this basis, the shop was more likely to take their time to be sure that all "wrinkles" were removed from the new automation before accepting a permanent payment plan.

An important impact of initial or temporary plans was found to be in there benefiting employees during the new job orientation phase. Most (74 per cent) respondents agreed that from their experience, preliminary payment offered a "helping hand" to employees in the "getting acquainted" stage. It also helped to motivate them in training and prove in preparatory to change-over to a final wage payment plan. Some representative comments volunteered by respondents in followup interviews, supported this typically beneficial aspect of these plans.

"Inspired operator confidence to learn and do better"

"Equitable, introductory and rewarding"

"Covered learning equitably"

"Payment was made even with limited output and machine breakdown"

"Prove in and training proceeded smoothly with workers not losing any money"

Twenty-six per cent of the respondents appeared to indicate dissatisfaction with initial wage payment plans not motivating workers. By this, they were actually referring to difficulties experienced with permanent plans as revealed in telephone followup interviews securing some supporting depth response in this respect. Further validation of payment difficulties occuring in connection with some automated work, was provided by a somewhat larger group (38 per cent) of respondents agreeing than disagreed, (33 per cent) that technological change necessitated new or different methods of performance evaluation which would place greater weight on work factors more pertinent to automated type work. This bears out a previous finding herein where "a different criteria for wages be used" aside from established method standards in order to better suit analysis of various automaticity levels. Additional validity was afforded by 45 per cent of the respondents agreeing (as compared to 40 per cent disagreement) that technological change requires the redesigning of job description formats, since work became less quantitatively measurable.

To summarize what is felt to be significant findings in this chapter, followup interviews with respondents experiencing difficulty with standardized way payment plans applied to automated work disclosed,

1. With the high levels of automaticity, the mechanization actually took control out of the tender's hands and he could not really be charged with and paid according to the amount of machinery under his control. With the lower levels of automaticity, control of the mechanization was more in tangible evidence and there was no problem in equating this and reflecting it with the size of wage rate paid. Wage structures based on this control were therefore inconsistent as dependent on the type of technological change and level of automaticity involved.

2. Difficulty was experienced in measuring the degree of increased responsibility of the machine monitor according to the mechanization's investment. Payment by this yardstick appeared realistic where control of the mechanization was tangible; however, controversy arose in other areas of automaticity where it became payment-by-luck and the worker in a shop operating expensive machinery, was fortunate. The toolmaker and machine maintenance skills on the other hand, were more in demand in all cases and no problem was therefore presented in paying according to the higher grade work definitely in evidence with an expensive automation of any level.

3. With most levels of automaticity, operator responsibility to control machine stoppages could be tangibly measured and thereby reflected in an equitable wage rate. However, in the case of the very high levels of automaticity, dependence on the tender's alertness and intelligence in diagnosing and preventing machine stoppages involving a large portion of the productive capacity, was unnecessary as the built-in automatic controls performed the "self correcting" function. In these cases, standard measures of job evaluation and wage payment did not provide completely equitable and satisfactory coverage.

In qualifying the variation in responses received from many of the engineers and engineering supervisors, who could be called specialists in planning for and installing varying degrees of technological change, it is understandable and logical that wage payment results differed in degree of satisfactoriness and fair compensation. It is accordingly consistent that 23 per cent of the respondents indicated automation, "makes present methods of job evaluation inadequate for accurately pricing machine-tending jobs"; whereas, a 42 per cent response disagreed and 35 per cent of the respondents indicated indecision due to conflicting experience.

It can only be deduced in concluding this section, that no specific method of payment provided satisfactory wage payment coverage for all cases and levels of automaticity.

Time Payment. In the opinion of most (63 per cent) of the respondents, the desirable wage payment plan to adequately pay workers on automated jobs was time payment. Several basic reasons were given by them.

1. In many cases of automation, the machine paces the man and his exact impact on the degree of productivity can not be measured.

2. The uniform time payment provided, compensates for machine stoppages the tender has no control over, including other machine slow downs due to mechanical malfunctioning.

3. It applied to work controlled rather than performed and thus the operator's efforts are not directly measurable particularly in the maintenance jobs and frequently in mechanized production work.

4. Time payment is the most practicable, particularly where the machine controls the production process over 60 per cent of the manufacturing cycle.

Some supporting details regarding the preceding actual situational reasoning favoring time payment were further indicated by respondents. At the risk of being somewhat repetitious, it is felt necessary to further validate a point. A majority (89 per cent) response reported experience with automated work where the job made payment on a time basis more desirable specifically because the units of output were not distinguishable and measurable as related to the machine monitor's efforts. e.g., By turning a valve or flicking a lever, granulated polyethylene compound flowed from storage bins into extruder hoppers as required for the manufacturing process. The man's efforts to remotely control this operation on an incentive basis would be difficult to access.

A similar proportion (89 per cent) of respondents reported that the technological changes they were associated with were better adapted to time payment as the employees had little control over quantity of output. This was due to high level mechanizations running by themselves or shutting down when a machine setter or special maintenance man was required to service them with the monitor standing by as an observer. The majority of respondents further indicated that there was no clear cut relation between effort and output and work delays could be frequent and beyond the monitor's control.

Quite interesting was the experience of most (64 per cent) of the respondents that time payment was used also in automated work where product quality was especially important. Many respondents reported that while output increased on incentive paid work, the quality of product manufactured, was not particularly the concern of the operators as long as they made their rate.

Also significant was the 59 per cent respondent indication that payment on a time basis was more desirable because the shop supervisor knew from an established history of output per shift, what constituted a fair day's work. Lower output than usual, indicated a poor tender or low morale. Rotating people was the measure taken to correct abnormally poor production results.

A final item of interest in concluding the discussion of this section, concerned the experience of 57 per cent of the respondents associated with work on a time payment basis. They indicated that cost control does not require precise advance knowledge of labor costs per unit of output where employees are completely aware of the business need to make the products as economically as possible in order to remain competetive.

Incentive Payment. There was enough (37 per cent) of a respondent indication of payment by incentives in some types and levels of automaticity, to substantiate its practicality also.

Some basic reasons were given by the respondents.

1. Where it was possible to relate wages and output in such a manner that earnings are in direct proportion with output and they varied according to the level of production, incentives proved equitable.

2. In the lower levels of automaticity, the labor cost still represented a fairly substantial part of the product cost and it was not difficult to apply standard incentive plans accordingly.

3. In most cases of applied incentive payment to mechanization, the productivity per machine operator was tangibly measurable.

4. Where the product characteristic did not include close parts tolerance adherence and/or rigid finish requirements, and the degree of productivity was determined by the operator, incentives proved beneficial to both company and the worker.

Supporting survey findings definitely indicated that most (62 per cent) of the respondents contended circumstances inverse of the above four reasons, greatly reduced the effectiveness of piece rate incentive program application to advanced technological change.

The same proportion (62 per cent) of respondents also indicated that incentive wage payment difficulties were created when conditions outlined earlier in this section, were not present. Typical difficulties were of operators not feeling they were being paid enough, the union asking reconsideration of reject drop out allowances where the operator had little control of the machine, and the engineer's contending that the shop could make the rate if they tried.

CHAPTER V

WORKERS AND UNIONS

When various technological changes are introduced, it is necessary to consider both the reaction of the workers and their union. The measures taken to prepare the employees and their representing organization are most important as this is the stepping stone to the degree to which automaticity may be accepted or resisted. Employee and union reactions to any change large or small, can be vital to its immediate success or, a prolonged period of introduction. The manner in which one case of advanced mechanization is introduced, may influence the reaction to and acceptance of future degrees of automaticity.

A general survey of literary references reflect various findings associated with industrial relations activity concerning workers and their union in reacting to technological change. Beginning with feelings of workers in respect to introduced automaticity; Faunce notes,

> "Workers in the plant also reported increased feelings of tension on the job resulting primarily from the increased rate of production and the amount of attention required by the job."

In contrast he observes,

> "A majority of workers in the plant, however, preferred their present automated job to non-automated jobs in the older plants."[1]

---

[1] Jacobson and Roucek, p. 49.

The Department of Labor's study associated with automating electronic equipment production reports,

> "The new methods apparently have been accepted by the workers so far as part of the normal process of shop changes".[2]

Another Department of Labor study concerned with modernizing a petroleum refinery concluded,

> "the refinery's workers recognize the inevitability of technological change and its importance for the company's growth".[3]

There apparently is a sense of worker fear and uncertainity with initial change followed by acclimation to the new or changed job conditions and a returned feeling of familiarity and security.

Union attitudes were found to be somewhat more impersonal with a greater sense of perspective in the overall. For example, Faunce states,

> "The grievance rate in the automated plants studied did not differ appreciably from non-automated plants of the company at the time of the study."[4]

Walker on the other hand, found a greater union activity associated with bargaining in connection with seniority rights in employee selection for and disposition of surplus workers as a result of automated work.

> "The controversy covered a longer span of months, and probably consumed more time of management and union officials than any other connected with Number 4 Mill."[5]

---

[2]Bureau of Labor Statistics, Report No. 1, p. 14.

[3]Bureau of Labor Statistics, Report No. 120, p. 31.

[4]Jacobson and Roucek, p. 47.

[5]Walker, p. 177.

The Department of Labor's study of automating electronic equipment production, clearly describes union attitude in negotiating changes associated with automation.

> "The union officials indicated that automation, continuing technological progress of the past, is likely to benefit workers or a group and therefore was not causing the union any unusual alarm. The union is mainly concerned that its members obtain a share of the gains of new mass production techniques and therefore strives to increase wages and related benefits. It also wishes to minimize the hardship suffered by individuals, whether temporary or more enduring."[6]

On preparing the union in advance of technological changes to come, the Department of Labor's study of a modernized petroleum refinery is very explicit.

> "The changes introduced - - - were also preceded by notice to the union officers of the refinery's plans 15 months prior to the changes. Management and union representatives discussed the number of workers required, their wages, and qualifications."[7]

On preparing employees for technological change, the Department of Labor's study of an automatic airline reservation system reports,

> "First, stories were published in the company's house organ describing the system, emphasizing its value to the employee - - - etc. To dispel fears of displacement, the personnel office informed all employees that no one would be laid off or downgraded as a result of the installation of the new system."[8]

These are some measures if not taken by management preliminary to and

---

[6]Bureau of Labor Statistics, Report No. 1, p. 15.

[7]Bureau of Labor Statistics, Report No. 120, p. 13.

[8]Bureau of Labor Statistics, Report No. 137, p. 11.

during technological change, influence worker and union attitudes adversely. There may be more responsibility; in fact, an obligation on managements' part to prepare the worker for the automations to come than many would realize. The sociological aspects of technological change are becoming more important and in many cases, equal to the engineering and technical prowess necessary to reduce overhead, and maintain or improve profit margins in the face of rising competition.

Workers Attitude in General. Having reviewed related research by others, let us see how the company approached the problem of introducing technological change to the workers; and the associated reactions that resulted. In a major portion (89 per cent) of the advanced mechanizations, the shop workers involved were informed ahead of time concerning a planned automation. Respondents indicated that as little as one month and as much as twelve months in advance were the intervals of prior notice in this respect. In respondent followup interviews, it was found that the interval length of advance notice to workers was, in the overall, directly proportional to the size and scope of a planned technological change.

A combination of verbal and written information was usually employed for communicating proposed changes in advance. There were engineer - shop supervisor discussions and conferences, and occasionally, meetings with the employees involved, were scheduled. In this respect, talk-back sessions improved employee-management relations and cleared up misunderstandings that employees had. The written information was comprised representatively of company paper releases on the coming technological changes; preliminary instructions for pre-training purposes, and manufacturing layout instructions finally covered the newly introduced processes in detail. This included shop supervision, workers, and, as key workers served as stewards, the union, who received advance notice of the planned changes simultaneously.

It was interesting to find that most (29 per cent) of the respondents experienced actual benefits associated with the introduction of various automations while 21 per cent indicated no direct benefit. In this respect, an initial feeling of insecurity on the worker's part, precluded any appreciable degree of realised satisfaction with the new or changed job. The respondents definitely contended that communicating with shop workers in advance, helped towards adjusting more easily toward technological change. A categorical summary of representative comments in this respect indicated in the order of five main areas of benefit.

Benefits derived from Communications	Frequency of Respondent Experience
1. Reduced employee resistance to change	59%
2. Received more cooperation from workers	18%
3. Miscellaneous -- Increased employee interest, reduced fears and tensions and better worker understanding was secured	13%
4. Fewer personnel problems were experienced	5%
5. Workers showed enthusiasm and acceptance of new rates faster	5%
	100%

The major benefits associated with effective communications are evidently a reduced employee resistance to the new or changed job in additon to greater worker cooperation.

Another significant finding was secured from the survey question, "What technological change is the most challenging to advance to the shop and secure worker acceptance and cooperation?" To emphasize the aspect of worker cooperation and acceptance, a detailed analysis follows. More (52 per cent) of the respondents experienced substantial alterations in existing facilities as the most challenging to introduce, than those (48 per cent) that had introduced new or substantially different manufacturing techniques and equipment. In both respects, this was related back to the worker's initial reactions to technological change accordingly. It should be noted that the workers' reactions and attitude could not be directly surveyed by the writer in view of the large scope of technological change coverage associated with this thesis. This information was therefore secured on a secondary basis through respondent experience and resulting interpretation in relation to each respective automation involved.

<u>Modernization of Existing Facilities</u>. The larger proportion of respondents experiencing greater effort in coping with automating existing work, had more than a little difficulty convincing workers because of the following representative reasons.

1. Workers resistance to change was observed to be greater. Having established themselves on a job that they were familiar with, it was a blow to their self confidence to accept an unknown quantity with the job newly automated.

2. It was observed more difficult to change established routines than to start fresh on entirely unrelated work.

3. Operators on being informed of the change to their job, questioned more, resisted more and were more hesitant to change.

4. It was observed to be more upsetting to personal habits and daily production; hence, any change to the existing job was looked on with suspicion.

From the above representative findings of worker initial attitudes to technological change, it would appear difficult to introduce automation; however, the writer wishes to stress that these were merely worker initial feelings after the first few weeks. Without advance information, the worker attitude would have been much more militant. After considerable training and a breakin period of from 3 to 6 months, feelings were much more stabilized and worker cooperation and acceptance were assured.

Introducing New Manufacturing Operations. Those respondents that experienced a greater challenge with new manufacturing techniques over changing established methods did so for the following representative reasons.

1. "Something new will not work, since it hasn't been tried before," was a representative worker quote contributed by a number of respondents.

2. Resistance to new techniques and equipment was also observed.

3. Workers seemed to adapt better to entirely new processes as no difficulty was experienced with having to change old habits and prejudices.

4. Some observed that new work involved more operator training for proper control of the automation.

It should be noted that there is some similarity of initial worker feeling whether an existing manufacturing condition is modernized or a new process is introduced. There is some contrast however; more resistance in the former and less in the latter situation to automation's introduction.

In the overall, 75 per cent of the respondents reported than less

(25 per cent) that automated jobs created professional pride in the workers. Respondents indicated that the new or changed jobs associated with a mechanization, gave the workers a greater feeling of importance and more personal accountability. The responsibility whether tangible or not, of controlling an expensive and complicated manufacturing operation with a certain level of automaticity, appeared to appeal to the workers.

Many (71 per cent) of the respondents indicated that workers did not experience any greater job tension with the new or changed job. This was found to be related with adequate preparation and training of these people before introducing automaticity as another proof of the value of advance communication. Eighteen per cent of the respondents indicated increased job tension. This was found to be a result of the added production speed, the new work, with an inadequate orientation and break-in period, the consequence of error and, the added pressure to exploit the new technology to the fullest. The remaining 11 per cent response indicating a reduced tension, did so on the basis that the degree of tension diminished where experienced people were found and utilized. The type and varying level of automaticity had, of course, a bearing on the above various findings. Mann and Hoffman found only a moderate level of tension several months after a change to automated work in a power plant.[12] Consequently, there is considerable disagreement in this area.

A specific test of worker attitude in general was secured from almost

---

[12]Mann and Hoffman, p. 207.

a unanamous (96 per cent) response to the survey statement that, "automation did not cause any uneasiness among workers." In fact, respondents contended representatively that it lowered any trend toward disturbance. They stated that workers were anxious to be picked for the new and changed jobs which looked more glamorous and possibly paid higher in some instances. On the other hand, the 4 per cent minority response was based on the fact that in the lower levels of automaticity, workers that were initially able to meet output quotas, were criticized as, "being too eager" by others who could not or would not become proficient promptly. Their particular instances involved incentive pay groups.

A somewhat related survey question, "Did the technological change tend to strain work relations?", was answered by respondents in a manner to support the findings here in connection with tension and also, disunity. Eighty-nine per cent of the respondents had experience with a variety of automated work where nothing but excellent work relations existed. This positive situation was associated with proper worker preparation and a developed familiarity with the new or changed work, as contributing factors favoring a good work atmosphere. On the other hand, a small (11 per cent) number of the respondents had experience with certain levels of automaticity where strained work relations were initially observed. This was due primarily to accelerated retraining and transfering of workers to other jobs, some workers claimed the new pay rates were unfair at first and, some workers had difficulty in learning new methods.

Union Attitudes. With worker consideration and associated feelings relating to automated work reviewed, let us see how union relations and attitude were affected. It should be mentioned at this time that no dramatic union difficulties or crisis were found in this survey of technological changes. Negotiations of any significance were usually associated with periods of union contract renewal and were not directly related to automation per se.

Ninety-two per cent of the shops where the technological changes took place, were unionized. The remaining small segment of non-unionized shops covered in this study was primarily in new startup plant areas. In 55 per cent of the cases surveyed, respondents indicated that automation did not tend to affect the size of the bargaining unit; mainly, because the displaced workers were utilized elsewhere within the union's coverage, e.g., girls formerly working on manual connector insulating lines were transferred on similar work in the same shop branch; however, this was in another building a considerable distance away. In the remaining 45 per cent of the automated projects concerned, the bargaining unit size was reduced. Followup interviewing disclosed that displaced workers were retrained and placed in other areas of the business under different union representation, e.g., some production workers transferred (based on their background and qualifications) into the trades area as helpers in training; or, displaced assemblymen or layout operators with suitable education backgrounds, were accepted in white collar work as technical assistants or engineering associates.

A check of all technological changes surveyed indicated that in no way were unions asked to participate before, at the start or after facilities were installed and neither did they play any active part in effecting new working conditions due to automation. Qualitatively, the unions did not take the initiative in helping develop working conditions associated with automation's introduction in the creative sense, e.g., finding ways to reduce worker tension or applying biomechanics to alleviate worker fatigue, etc. The unions were more interested in actively pursuing representation of workers such as in protecting their rights with respect to seniority and a fair share of wage payment etc. Management reserved the right to plan and assume its responsibility to justify and effect transitions to various levels of automaticity. As has been discussed herein, adequate communications were given in most cases, in advance of planned automations which, incidently, was in accordance with contractual agreement providing for notification of the union. Respondents indicated that union notification of planned changes was followed without exception.

It was interesting to note what feelings unions had regarding innovation. In 84 per cent of the cases of introduced automaticity, no particular feeling one way or another was registered with respondents. However, in the remaining (16 per cent) of the cases the following representative comments were made by respondents.

> "In the case of eliminating several bench jobs, the union wondered where the displaced workers would go".

After being notified of arrangements to transfer these people to other work, the union was satisfied.

> "With communications this lowered union antagonism toward automation."

> "Initially, the union thought the workers would work harder on the new jobs but it was found later not to be so."

> "Union feeling was predicated on workers not losing any earnings in the transition from the old job to the new one."

From the preceding, it can be concluded that when proper communications and feedback between management and the union transpired, relations improved considerably and worker cooperation was secured.

A validity check of the above findings was afforded somewhat by an 83 per cent response to the survey question.

> "Does automation tend to increase union activity?"

Seventeen per cent of the technological changes introduced in general caused the union to increase its activity by more frequent contacting of employees than formerly. This was done in order to secure reactions (likes or dislikes) to new jobs. Also, the union gave special effort to stress to management that seniority be acknowledged over capable workers with little service. Only where older employees could not meet automated job demands with adequate demonstrated performance over a trial period of time (usually 3 weeks), were shorter service workers permitted the job.

Of all the technological changes surveyed, a very small percentage influenced a variation in work rules. In this respect, more freedom was afforded the machine tender as an individual no longer belonging to a work group as such. Rest periods or coffee breaks were taken when the machine was down for adjustment or being lubricated etc. Although classed in one pay group along with other manufacturing operations, the need to conform to bench assembly work habits for example, was not present and the worker was therefore freer to move around, take a smoke etc., whenever the mechanization permitted this individual action.

In 91 per cent of the automations, union attitude towards associated job evaluation connected with newly automated positions was indicated by respondents to be neutral. However, there were some (9 per cent) cases of difficulty surveyed also. They involved jobs set up on an incentive payment basis. Essentially, the union wanted to make sure that employees were being treated fairly in connection with various work duties and limitations of the job. In some cases, the union questioned whether job grading was evaluated too low for newly automated work. An example in this respect covered machine stoppages and marginal quality product, preventing the tenders from meeting production quotas and making sufficient earnings under the standard incentive plan. The union argued that in this specific instance, machine malfunctioning resulting in slow down in production and a marginal quality product, was a non-operater responsibility condition. It was not in the tender's labor grade and not comprehensively identified in his manufacturing layout instructions. Compensation was accordingly approved for this condition by the engineer; however, followup telephone interviews with respondents definitely indicated this to be a common problem in applying incentive plans to automated work.

Associated with the latter discussion it should be clarified that from this survey, 90 per cent of the respondents reported no more and no less grievances than with the old jobs. Where grievances appeared to increase somewhat (5 per cent), this was largely associated with production rates being set too high in view of mechanization performance difficulties. On the other hand, grievances appeared to decrease in 5 per cent of the cases due primarily to greater job satisfaction and equitable pay treatment of operators. In these cases, the respondents representative reply was,

"gripes were down and constructive suggestions up"

This was reported to always indicate excellent worker morale.

In most of the foregoing areas of difficulty, discussions and debate were usually between the first line shop supervisor and the manufacturing engineer over specific inequities. Respondent reports verify this, as no significant union demands were made nor were new labor issues created from this overall survey of various technological changes.

Union - Company Agreement. It is appropriate to summarize this chapter by stressing what is felt to be important points of representative union - company agreement which basically allow flexibility for change.*

On mutual cooperation,

> "Whereas, the Company and the Union wish to encourage the highest possible degree of friendly, cooperative relationship between their respective representatives at all levels, and with and between all clerical employees included in the Bargaining Unit, and recognize that such relationship depends in a large measure on attitudes between the people involved;"

On Union recognition,

> "The Company hereby recognizes the Union as the exclusive representative of the salary rated, non-supervisory employees of the Manufacturing Division of the Company."

---

*Pertinent information will be taken from a current "General Agreement" between the Company and the Local International Brotherhood of Electrical Workers, AFL-CIO, effective 1/3/67.

On movement of personnel,

> "The Company desires to maintain employment as near to a constant level as possible. Both parties recognize, however, that the needs of the business and its efficient operation may necessitate reassignment of personnel or the addition to or decrease in the working force."

And finally, on Union security,

> "Each employee who is a member of the Union on or after the 30th day following the beginning of his employment or on or after the 10th day following the effective date of this Agreement, whichever is later, shall, as a condition of employment, pay or tender to the Union an amount equal to the periodic Union dues."

CHAPTER VI

CONCLUSION

In view of the large scope and variety of information secured and presented from field questionnaire and followup interview feedback, specific conclusions and associated generalizations have been made throughout the structure of this thesis where pertinent to the specific topic.

As the reader can perceive, this empirical study differs from the classical studies of Faunce, Mann and Hoffman, Walker and others. It encompasses a variety of technological changes at many different plants of the company and also includes various degrees or levels of automaticity. One must then expect results to vary from those which would be expected from only one isolated case of technological change, e.g., specific conditions and responsibilities of one level of automaticity, can and will be different for other levels of technological change, etc. In this overall study of many diverse automations and associated characteristics, at least two perspectives may there be afforded the reader.

1. A composite picture is provided as compared to results associated with isolated studies previously known to the reader.

2. A broader more comprehensive understanding is gained aside from the set pattern of results that have been expected of individual studies.

In uniquely reporting therefore on the findings associated with a multitude of improved or new manufacturing processes as compared to one, a general approach must be taken now to attempt summarizing overall effects associated with each case of advanced mechanization. Obviously, the results presented can only be as good as the quality and depth of information secured; primarily, in the remote manner secured from respondents as originally described in the Introductory Chapter. The individual reader can also make his own inferences and deductions from the findings presented in this thesis in addition to the writers analysis.

Before proceeding, it is felt necessary to present the impact of the large number of technological changes surveyed in general statistical terms. The total cost of installing all of the various technological changes covered as specified by the respondents, was estimated to be in the order of $12,000,000 with a representatively effected annual savings of approximately $16,000,000. It is interesting to report also in the overall, that the cost of making the product was lowered from 10 per cent to as much as 90 per cent in some cases as a result of automating. A representative annual output per automated job surveyed, varied from 1,000 to 550,000,000 pieces of product manufactured.

Employment. Jobs were eliminated primarily during expanding business conditions. Personnel requirements associated with the automated work were from 1/3 to 1/2 less than they were before improvements were made on the old job. From two to as much as fifteen jobs were combined with some unskilled, but mostly semi-skilled jobs primarily affected. The surplus workers were transferred to other jobs for the most part.

Retraining was necessary and most important in preparing displaced or new workers in general. Considerable effort was made to place surplus people on other work which in turn helped attitudes and improved worker morale thereby siding in reducing resistance to change. Less worker tension was noted in those cases where training was done on the job as compared to complete classroom training in the overall.

Women under 40 were preferred and worked out better on automated work. The least adaptable were older women in the 55-60 age group with long service.

Jobs and Job Content. Some jobs were eliminated such as manual labor, handling and loading in the unskilled category. However, a high degree of reduction or complete elimination was experienced in semi-skilled manual assembly work.

New jobs were added as required by the demands of advanced mechanization such as machine tenders, monitors and special machine maintenance of the mechanical-electrical troubleshooter and adjuster types. These were newly created jobs while additional work as an outgrowth of existing jobs was also provided. This included machine setters, layout operators and conventional machine and tool maintenance jobs.

Jobs changed primarily by combining them and substituting machine control in place of human control in varying degrees. Significantly, human inspection was replaced to a large degree by the built-in monitoring operations, fewer motions were required with a larger degree of observation, attention, alertness and diagnostic effort required in the lower levels of automaticity. The amount of mental control tended to be reduced with advancing stages of introduced technological change. In associated maintenance work, greater job responsibility was observed to be representative of advancing levels of automaticity in general.

The automated work had more variety with less monotony involved on machine monitoring and setup work where 50 per cent or more of the job content was controlled by the operator. As the work became more highly mechanized, physical demand became less and less.

Changes in existing jobs were generally effected by an increase in electrical, hydraulic and pneumatic maintenance skills where more personal comprehension, initiative, judgement and capability were needed. Upgradings occurred as a result of this and in relation to the increased maintenance requirements associated with rising levels of automaticity.

On the other hand, production skill needs decreased as the level of automaticity increased. More machine tender and monitor skill was required only in lower level automations where the operator still controlled a large portion of the manufacturing process.

Education needs varied with the level of automaticity concerned. That is, they rose to fulfill the higher calibre of maintenance required commensurate with increasing levels of automaticity and were somewhat less or the same educational level to fulfill average production work demands associated with increasing levels of automaticity. The inverse was true of educational needs with decreasing levels of automaticity in connection with maintenance and production type work.

Wage Rates. In the majority of cases, the level of worker wages increased over those where the technological change had no effect on wage levels. Attractive pay scales included both production and maintenance jobs.

Temporary payment coverage was the stepping stone to establishing permanent rates. In this interim period, allowance was made for adequate worker payment during operator training and/or prove-in of new mechanization designs. Pay relationships acceptable to the workers and unions were noted in a majority of technological changes due primarily, to the allowance of enough time to properly evaluate the new or changed work during these periods of introducing automation. There was a smaller group of respondents who questioned that the various levels of automaticity could be properly evaluated for payment using standard methods of job evaluation. This was due largely as the exact amount of effort contributed by tenders or monitors could not be completely measured in many cases of automation.

No specific method of wage payment provided completely satisfactory coverage for every case and level of automaticity. A substantial portion of respondents had more satisfactory experience with time payment particularly in these areas of automaticity where it would have been difficult to measure and pay for operator performance on an incentive wage payment basis. Respondents contended that time payment did not precipitate conditions where a sacrifice of product quality was presented to accent quantity of production as normally stressed by incentive rate payment.

On the other hand, where the level of automaticity was such that a large part of the production cost was comprised of direct operator effort, incentive payment was completely satisfactory. The output of this type of automation was directly measurable in proportion to the attendant's controlling effort of the mechanization.

In comparing respondent experience including the writer's, with respect to the two basic plans of wage payment, there is general concurrance on an aspect of workers controlling their own work. This is, that no matter how exact or detailed manufacturing instructions were developed by the engineers for shop adherence, incentive plans were not completely satisfactory in influencing operators to completely adhere to the issued instructions. In many cases, workers were found to use personal ingenuity to circumvent and produce the product in a different and often, equally effective manner.

It is obvious at this point that the writer has found no overall pay system which can be applied uniformly where fully automated and semi-automated jobs are concerned. The various findings indicate that what worked well in one set of technological change circumstances does not completely apply to other cases. This indicates that an open mind must be kept in progressively applying the most desirable payment system to the specific technological change which will be benefited the most.

Workers. In a majority of the cases, workers were informed sufficiently ahead of technological change introduction to reduce employee resistance to change. This resulted in greater cooperation and better worker understanding of the job as a result of reducing fears and tensions.

Modernizing existing manufacturing facilities appeared to be the most demanding from the human relations standpoint with respect to the greater need for communication. Also, considerably more transfering, training and motivating workers was necessary as compared to that required for introducing product manufacturing automations where more people were hired rather than transferred. In automating existing manufacturing facilities, there was an apparent greater urgency to change over in addition to affecting a larger proportion of people on the job. In this respect, proper worker preparation, developing familiarity, and proficiency with new or changed work, were the key points that were found to aid worker transfer and rotation goals. Where accelerated retraining and movement of workers to accomplish crash programs was experienced, a greater degree of strained work relations ensued.

Unions. In a shop atmosphere largely unionized, an amicable relationship was observed to exist between management and labor. A strongly accountable management approach was found to be representatively associated with technological change's introduction and operation in all cases. Unions tended to accept automation accordingly; however, they were primarily interested in protecting employee seniority rights at the same time strongly pressing for improvement of worker remuneration as a greater share of the benefits from effected automations.

The explicitly stated and thoroughly negotiated official agreements realized between management and labor, at the bargaining table during contract renewal periods, was observed by the writer to be the single largest reason (aside from maintaining friendly work relations on the job) contributing to the Company's long history of excellent labor relations.

Individual personalities and situational variables were the main sources of occasional friction and difficulty between engineering and shop operating people (supervision and workers alike). Recognition of social as well as technical problems by engineers and shop personnel working in mutual cooperation and then taking appropriate measures to work out satisfactory solutions also was an important aspect leading to successful introduction of various levels of automaticity. Only where complacency and indifference to rising personnel or operational problems was observed, were difficulties of any significance experienced by respondents.

Predictions. The preceding general observations which conclude this overall study, afford some perspective which leads the writer in looking ahead, to make some predictions.

1. Essentially greater joint problem solving is and will become increasingly necessary on the part of engineering management and the shop to recognize their mutual responsibility in meeting the competetive challenge to manufacture a high quality product at reasonable cost to the customer. This means the engineering supervisor and his engineers recognising that human relations and knowledge of the social sciences are becoming more, not less, important in an age of advancing technological change. It also means that the shop supervisor and his employees becoming increasingly more cognizant of the need to change and cooperate accordingly in order to keep their product design and cost competitive with other similar products made in the Company and outside suppliers as well.
2. More motivational measures will also become increasingly

necessary to rely on and pay the worker to perform the job in the best manner equal to his maximum capability. There must continue to be general instructional guide lines to assure a tangible basic to performing or controlling work. However, the writer has observed that the worker definitely performs better if motivated to use his potential capacity for work rather than being instructed inflexibly to follow a set pattern of obligations. This, while satisfactory, leaves no flexibility for personal work contribution. A timely problem which is associated, recognizes the scarcity of engineers of all kinds and the fact that every manufacturing job cannot possibly be covered and periodically reviewed in minute detail to assure the best possible current way of performing the job.

Therefore, the work situation should become established nearer and nearer to letting employees become more personally accountable. This is being advocated on the basis that,

1. Most employees do not dislike work and can exercise self direction and self control to accomplish the company objectives and goals to which they accept as being theirs too. Under such excellent supervisor-employee conditions, they may not only accept but will also seek responsibility.
2. The average employee has a relatively high degree of personal initiative or creativity, and it is the shop supervisor's job

to perceive and work out a suitable working relationship and atmosphere which would be conducive to utilize this employee potential for mutually working toward solving organizational goals and problems.

3. Employee complacency embodied by low ambition and lack of interest usually is the result of the work climate and job experience, and as such, is not directly associated with human nature.

4. Most employees have a work performance potential considerably above the normal level of their work. It is the shop supervisor's responsibility with the help of the manufacturing engineer, to find new and more effective ways of organizing and guiding human effort.

In conclusion the writer contends that worker personal well being and job satisfaction are a part and parcel of culturing a work atmosphere conducive to self respect and a feeling of personal dignity. Only when the worker can be made to feel some sense of being self directing and having some voice in controlling the work situation, can the preceding objective be accomplished. There is room for management teaching and training as well as employee self direction in using personal initiative to perform the work in the best manner possible.

The foregoing should hopefully contribute toward realizing greater progress in more effectively and satisfactorily approaching and helping to solve the problematic impact of increasing technological change on employment, jobs, wages including workers and their unions.

BIBLIOGRAPHY

BOOKS

American Assembly, Automation and Technological Change, Columbia University, Prentice Hall, Inc., New York, 1963.

Beaumont, R. A. and Helfgott, R. B., Management, Automation and People, New York, The Book Press, 1964.

Bright, J. R., Automation and Management, Boston, Harvard University, Mass., 1958.

Diebold, J., Congressional Testimony taken from Morris Philipson's "Automation" - Implications for the Future, Vintage Books, Random House, New York, 1962.

Einzig, P., The Economic Consequences of Automation, Norton and Company, Inc., New York, 1957.

Friedmann, G., Industrial Society, Glencoe, Illinois, The Free Press, 1955.

Jacobson, H. B. and Roucek, J. S., Automation and Society, Philosophical Library, New York, 1959.
Chapter 4
The Automobile Industry - A Case Study in Automation
W. A. Faunce
Automation in the Electronics Industry
D. G. Mitchell
Automation in the Bell System
C. W. Phelen
The Nature of Automation in the Telephone Industry
J. A. Beirne

Killingsworth, C. C., Automation in Manufacturing, Proceedings of the 1958 Meeting, Industrial Relations Research Association.

Mann, F. C. and Hoffman, L. R., Automation and the Worker, New York Henry Holt & Co., 1960.

Miller, D. C. and Form, W. H., Industrial Sociology, New York, Harper and Rowe, 1964.

Patton, J. A., Littlefield, C. L., and Self, S. A., Job Evaluation, Homewood, Illinois, Richard D. Irvin, Inc., 1964.

Pollock, F., Automation, New York, F. A. Praeger, 1957.

Walker, C. R., Toward the Automatic Factory, New Haven, Yale University Press, 1957.

MONOGRAPHS

BIS Report #1, A Case Study of a Company Manufacturing Electronic Equipment, U. S. Dept. of Labor, J. P. Mitchell, Secretary, Oct., 1955.

BIS Report #120, A Case Study of a Modernized Petroleum Refinery, U. S. Dept. of Labor, J. P. Mitchell, Secretary, Nov., 1956.

BIS Report #137, A Case Study of an Automatic Airline Reservation System, U. S. Dept. of Labor, J. P. Mitchell, Secretary, July, 1958.

BIS U. S. Dept. of Labor, A Case Study of a Company Manufacturing Electronic Equipment, J. P. Mitchell, Secretary, Oct., 1955.

PERIODICALS

Adams, J. J. & Moyer, J. E., NLRB Threat to Managerial Freedom (Roadblock to Automation), Automation, Dec. 1965.

American Sociological Review, Automation in the Automobile Industry: Some consequences for in-plant social structure. June 1957.

Automation, London, Department of Scientific and Industrial Research, 1956.

Baldwin, C. and Schultz, G., Automation - A New Dimension to Old Problems, Monthly Labor Review, February, 1955.

McCarthy, R. C., Automation and Unemployment: A Second Look, Management Review, May, 1962.

U. S. Business, Time Magazine, August 17, 1962.

Walker, C. R., Life in the Automated Factory, Harvard Business Review, May-June, 1960.

OTHER SOURCES

Impact of Automation: A Collection of 20 Articles About Technological Change, Bul. No. 1287 (Wash: Goutt Printing Office, 1960)

PERSONAL INTERVIEWS

Bob Gorman and Hugh Young President and Official of the Western Electric Local of Communications Workers of America, respectively.

APPENDIX I

(COPY)

(Western Electric Company Letterhead)

September 12, 1966

TO ENGINEERING & SHOP SUPERVISORS & PROJECT ENGINEERS

A REQUEST FOR YOUR ASSISTANCE:

To fulfill graduating requirements in the Institute of Industrial Relations at Loyola University, I have chosen to review certain effects of Technological change on Industrial Work within our Company.

Specifically, I am attempting to secure a composite picture of the change, if any, in the worker's attitude, wage rates, job classifications, skills, fringe benefits, learning perception and creativity relationships with fellow workers, feelings toward and about the job and work atmosphere as well as supervisor-employee relationships, etc., from the engineers functional for introducing the changes.

Also, I plan to put together similar data from shop supervisors who helped make the automations work on the assumption that their influence is important to the worker affected by change and/or new methods of manufacture.

To do this job, I need your help! Your know-how and experience will be invaluable in completing the attached questionnaire, please. Your frank, unbiased and informative comments are solicited.

For purposes of analysis, your personal reply or that of your most knowledgeable engineer or section chief, as the case may be, is acceptable. I will be correlating replies from respective functional engineers and the interested shop supervision as well.

As the progress on my thesis is on a rather tight time schedule, please do not delay in going on to complete the questionnaire.

Please return the completed questionnaire A.S.A.P. No completed questionnaires will be able to be used after October 1, 1966.

Many thanks for your help

FRANK E. KIMMEL
Clearing Products
Engineering

APPENDIX I (continued)
(COPY)
(Western Electric Company Letterhead)

September 22, 1966

A FRIENDLY REMINDER

Several day ago you should have received a letter from me and a questionnaire. If you have already completed the questionnaire and returned it, I thank you. If not, would you please do it now!

If by any chance you did not receive a copy, please call Nancy Jelen on Coronet No. 354-3052 or 458-8000, Ext. 77 locally, and she will send one out to you right away. While this information is needed A.S.A.P., delayed replies* can be used one week later than Oct. 1st.

As indicated in my earlier letter, your answers to the questionnaire are important to the thesis while completing my evening graduate studies at Loyola. As with any research project, the value of the results is primarily dependent on the quality of data used. In this case, data quality is assured if the questions are answered sincerely and if all of the questionnaires are returned. Thus, even though your response will not be reported individually, the statistical significance of the combined response depends on the participation of each one of you, with the help of others if necessary, to fill out all aspects of the questionnaire.

The benefit to you for participating is intangible at best. However, let me say this: Western Electric and Loyola have allowed me complete freedom in selecting an area of study for my thesis. I have chosen to work in the field of industrial relations applicable to the impact of technological change on the work situation; first, because as an engineer, I hope to make a contribution to the profession's effectiveness, and second, because I am convinced that with more knowledge about the effects that any technological change has on Industrial work situations, it will be possible to create a guiding philosophy for better engineering and project introduction, enriching both the company and ourselves.

Naturally, no single study is going to provide all of the answers we seek, but at the same time I am hopeful of making a modest contribution in which your help is extremely important.

*NOTE: If the individual has been transferred, please forward; naturally, vacations, sickness & pressure of the business is unavoidable.

Thank you,

FRANK E. KIMMEL
Clearing Products, Engineering

APPENDIX I (continued)

PRELIMINARY QUESTIONNAIRE INFORMATION:

If you have directed, engineered, been included in, or been associated with introducing *Technological change or *Automation, then you can contribute valuable information by filling out the attached questionnaire.

Please complete this questionnaire following these general instructions:

1. Please do not read ahead, complete one question before proceeding to the next.

2. Most of the questions call for your professional knowledge and observations. Your first impressions are important.

3. As you will see, there are no "right" or "wrong" answers. As long as the answers you furnish reflect your honest viewpoint, this will be sufficient.

All data reported in the thesis will be on a group basis so that no individual identification will be revealed. (Unless you permit to be quoted)

Please return completed questionnaire to:

DEPARTMENT 2371
Western Electric Company, Inc.
Clearing Plant
5939 West 66th Street
Chicago, Illinois 60638

*Various Definitions: (1) Integration of machines, (2) linking machines together by means of automatic transfer devices, (3) mechanizing formerly manual or semi-automatic intermittent operations into a continuous process, (4) the use of tape and other automatic control devices to direct manufacturing operations of machines and machine systems using electronic or other components to regulate and coordinate the quantity and quality of production, (5) the use of devices which now do what men did before and (6) the substitution of machine power and control for human power and control.

Note: If you wish to recommend any other knowledgeable person that was also associated with mechanization introduction per any of the above definitions, a questionnaire will be promptly sent as you suggest accordingly.

NAME ____________

WORKS LOCATION ________

DEPARTMENT NUMBER _____

General

1. Are you or were you directly involved in introducing a technological change?* (Yes or No) ______

   a. Was this as an engineering supervisor _____
   (Pls. check one) shop supervisor _____
   project engineer _____

2. What product was involved?

   a. Was the product new ___ or old ___ or modified ___?

3. What was the representative annual production? (In thousands) ________

4. What was the representative cost of the product (per unit) before____? and after ____? the technological change.

5. What was the nature of the technological change? (Please describe briefly)

   a. Please estimate the total cost of installing the change. $________

6. Please check in the blank space the level of automation involved.

   a. Machine actuated by introduction of material ___, parts ___ or work piece ___. (Check one)

   b. Machine processes and reports status of action or characteristic of product ________.

*Defined as covered on the front explanation sheet of this questionnaire.

c. Machine signals as well as records ________.

d. Machine modifies its own actions ________.

e. Other ________. (Please explain)

7. How many separate operations were combined in one mechanized process? ________

a. What were they?

8. Please indicate your estimated cost of technological change introduction? $________ and the associated resulting annual labor and/or material savings $________.

9. With respect to the industrial work situation, did the automation affect:

Job Content	________
Job Classifications	________
Wage Rates	________
Unions	________
Ohter	________ (Please explain)

10. What was the name of the shop in which the technological change took place?

11. In respect to the automation, was it (Please check one)

a. Modernization of existing manufacturing process? ________
b. Introducing an entirely new process? ________

12. Do you feel it was a successful project? Yes _____ No _____

13. Aside from technical design and prove-in, did you have problems in planning for technological change? Yes _____ No _____

a. In introducing the technological change Yes _____ No _____

14. In planning for technological change, were any preparation measures necessary in the shop where this was to take place?

Yes _____ No _____

a. If yes, what were they?

15. Did you inform the shop workers involved ahead of time of a planned automation to come? Yes _____ No _____

a. If Yes, how far in advance?

b. What kind of information was passed on to the shop supervision?

and to the workers?

16. Did communicating with the shop workers in advance help any towards helping adjust toward Technological change?

Yes _____ No _____

a. If Yes, in what way?

17. Considering the problems presented by technological change on workers, please rank in order the importance of the following factors which helped your automations be accepted by the shop. (#1 being tops.)

RANK	
( )	Communications
( )	Advance planning
( )	Training workers
( )	Friendly supervision
( )	Worker recognition
( )	The work itself
( )	Salary
( )	Personal achievement
( )	Good working conditions
( )	Competent supervision

Comments:

18. What technological change is the most challenging to advance to the shop and secure worker acceptance and cooperation? (Check one)

( ) Introduction of new or substantially different manufacturing techniques and equipment.

( ) Changes in methods of operations that had involved substantial alterations in existing facilities.

Please explain (in what way):

19. Please indicate in numerical importance, the greatest degree of impact of automation on labor with respect to your own experience and observation: (In numerical order)

( ) Unskilled

( ) Semi-skilled

( ) Skilled

( ) Maintenance work

( ) Technical work

20. Composition of employee group displaced by technological change, by type of employment and skill level:

Type of Employment	Number of Employees
Production	______
Maintenance	______
Technical	______
Supervisory	______
Total	______
Skill Level	
Skilled	______
Semi-skilled	______
Unskilled	______
Total	______

21. Company aid to displaced employees:

Type of aid	Number of Employees
Referred to other: Companies for jobs	________
Shops for jobs	________
Retrained for other employment within the company	________
Paid relocation allowance	________
Given severence pay	________
Early retirement	________
Other (specify) ________________	________

22. Comparison of wage rates of workers reassigned or transferred to other jobs or shops within the Company.

New Wage Rate Compared to Old	Number of Employees
Higher	________
Same	________
Lower	________
Total	________

23. Manpower needs resulting from change:

a. List the new key jobs resulting from the change:

b. List those occupations which were in short supply for the first year after the change:

24. What is affected by Technological change to the largest extent? (Rank order)

________ Wage rates
________ Job status
________ Method of wage payment
________ Job classification
________ Worker intelligence need
________ Supervisory guidance
________ Skill
________ Other (specify)

25. How well adapted were workers for learning the new jobs? (Check one)

	Very Good	Average	Poor
a. Older (55 - 60)	( )	( )	( )
b. Middle (40 - 55)	( )	( )	( )
c. Under 40	( )	( )	( )
d. Women - Long service	( )	( )	( )
Short service	( )	( )	( )
e. Men - Long service	( )	( )	( )
Short service	( )	( )	( )

26. When your technological change took place, were workers:
(Indicate percentages, respectively, totaling 100%.)

( ) Transferred to other work
( ) Upgraded
( ) Downgraded
( ) Laid off
( ) Retired early

27. From your first hand impression, what impact did the Technological change introduced have on the workers involved?
with respect to: (Indicate better, lower, same, etc., with comments)

a. Workers attitude

b. Wage rates (higher, lower, etc.)

c. Job classification

d. Skills

e. Fringe benefits

f. Learning perception & creativity

g. Relationships with fellow workers

h. Feelings toward and about the job.

i. Work atmosphere

j. Supervisor-employee relationships

k. Please list and describe any other factor or factors not mentioned where the change created a noticeable impact:

JOB CONTENT

(Skill) 1. Was there a change in skill involved?

Yes _____ No _____

2. Which skill(s) were involved?

a. (Please indicate to what degree of change upward or downward in each respect) _______________%

3. Was education a factor in learning the new or changed job?

Yes _____ No _____

4. What kind of education helped the worker learn the changed job demands?

5. To what extent did education enter into helping the workers become proficient operating the mechanization?

0 _____ 10% _____ 25% _____ 50% _____ 75% _____ 100% _____

6. a. Were skills introduced on the new job that were not present before?

Yes _____ No _____

b. What were they?

7. a. Was upgrading involved?

Yes _____ No _____

b. If Yes, in what way?

8. a. Is more _____ or less _____ manual dexterity required with the new job?

b. In what respect?

9. Was the job accuracy changed? Yes _____ No _____

a. In what respect?

(Effort) 10. Does the new work have more variety? Yes _____ No _____

a. In what way?

11. Is the new operation routine? Yes _____ No _____

12. a. If the answer to Question 11 is no, what phase of the job presents constantly new problems to the operator?

b. What are the problems?

13. How did the old job differ with the new one?

14. Is more _____ or less _____ physical effort required with the new job? (Check one)

a. In what respect?

15. Compared to the old job is the work more monotonous _____ or less monotonous _____? (Check one)

a. In what respect?

(Responsibility)
16. a. With the technological change, has the money value of the manufacturing equipment changed?

Yes _____ No _____

b. In what respect?

17. a. Is it easier _____ or harder _____ to make an error in manufacturing the product by the automated method?

b. In what manner?

18. To what degree is the operator personally accountable for the newly automated operation?

15% _____ 25% _____ 35% _____ 50% _____ 75% _____ other _____

How much? _____________(Please check one)

a. Is this more so _____ or less _____ than on the old job?

b. To what extent?

19. Are the working conditions cleaner _____ safer_____

healthier _____ less fatiguing _____?

JOB CLASSIFICATION

1. Were any occupations eliminated? Yes _____ No _____

2. What occupations were involved?

3. a. Were any occupations added? Yes _____ No _____

   b. How many? _______

   c. Please list them.

4. Were they newly created _____ or already established in the Company _____? (Check one)

5. Please check the educational level required to perform a newly created occupation _____ or the most difficult mechanization control job _____. (Select one)

   a. Grammar school education _____
   b. 2 Years high school _____
   c. 4 Years high school _____
   d. 2 Years college _____
   e. 4 Years college _____

6. What duties were required in the above job classification?

7. Please check the experience level required to perform the newly added occupation of the highest level.

   a. Not exceeding 3 months _______
   b. Over 3 months but not exceeding one year _______
   c. Over one year but not exceeding three years _______
   d. Over three years but not exceeding five years _______
   e. Over five years in a skilled occupation _______

8. What kind of experience was required in the above job classification? (Please describe in terms of job involved.)

9. Please check the initiative and ingenuity level required to perform the newly added occupation of the highest level.

   a. Ability to understand and follow simple instructions ____
   b. Ability to perform standardized or routine operations ____
   c. Ability from general instruction to work under minimum direction ____
   d. High degree of ability to understand and work unaided ____
   e. Outstanding ability to think and use ingenuity, initiative and judgement without direct supervision ____

10. From the standpoint of physical demand, please check the degree of lifting effort expended in connection with the above job classification:

a.	Continuous	____	50% or more of the time
b.	Frequent	____	10% to 50% of the time
c.	Occasional	____	2% to 10% of the time
d.	Negligible	____	Up to 2%

11. Please check the physical demand level required to perform the above job classification:

   a. Light work involving little physical effort ____
   b. Work requiring continuous lifting over 1 lb. & up to 5 lbs. ____
   c. Work requiring continuous lifting over 5 lbs. & up to 25 lbs. ____
   d. Work requiring continuous lifting over 25 lbs. & up to 60 lbs. ____
   e. Work requiring continuous lifting over 60 lbs. or equivalent pulling or pushing ____

12. Please check the mental and visual demand level required to perform the above job classification:

   a. Work performed is practically automatic requiring only occasional mental and visual attention ____
   b. Work performed requires frequent attention, mental, or visual, or both ____
   c. Work performed requires continuous attention, mental, or visual, or both ____

d. Work performed requires high degree of concentrated attention, mental, or visual, or both ____
e. Work performed requires exacting degree of concentrated attention either mental, or visual, or both ____

13. Please check the degree of responsibility for equipment or process required to perform the newly added occupation of the highest level:

a. Work in which there is no probability of damage to equipment or process, or work in which the failure to exercise proper care could result in a loss not to exceed $5.00 ____
b. Work in which the failure to exercise proper care could reasonably cause damage that would exceed $5.00 but seldom $25.00 ____
c. Work in which the failure to exercise proper care could reasonably cause damage that would exceed $25.00 but seldom $250.00 ____
d. Work in which the failure to exercise proper care could reasonably cause damage that would exceed $250.00 but seldom exceed $1,000 ____
e. Work in which the failure to exercise proper care could reasonably cause damage that would exceed $1,000 ____

14. Please check the degree of responsibility for material or product required of the employee to avoid waste or loss of raw material or product.

Work in which the failure to exercise proper care could reasonably result in a loss not to exceed:

a. $10 ____
b. $10 but seldom $100 ____
c. $100 but seldom $250 ____
d. $250 but seldom $500 ____
e. $500 ____

15. Please check the degree of responsibility for safety of others required to perform the above job classification:

a. Involving minimum responsibility for safety of others ____
b. Exercise reasonable care in order to avoid injury to others of a minor nature ____
c. Exercise considerable care in order to avoid injury to others of a lost time accident nature ____
d. Constant care to avoid major injury to others resulting in partial disability such as loss of arm or leg, etc. ____
e. Where safety of others depends entirely on correct action where accidents would usually result in death or total disability ____

16. Please check the degree of nonsupervisory responsibility for instructing, assigning, coordinating and maintaining flow of work within a group:

a. Negligible ____
b. Partial responsibility for instructing or directing designated people ____
c. Full responsibility for instructing or directing designated people ____
d. Partial responsibility for maintaining flow of work in addition ____
e. Full responsibility for maintaining flow of work in addition ____

17. Please check the working conditions associated with performing the newly added occupation of the highest level:

a. Godd shop conditions and clean work ____
b. Good shop conditions where work involves some dirt, oil, grease, or noise, etc., but does not disturb physical or mental well being of the employee ____
c. Somewhat disagreeable work involving a continuous element or combination of above (b) conditions including heat, cold, wet, noise, etc., of major importance but not continuous ____
d. Disagreeable work having an undesirable element or combination of factors of major importance such as heat, cold, wet, fumes, noise, etc., but which are continuous ____

e. Having the most disagreeable extremes of above mentioned factors and conditions including exposure to extreme conditions of dampness, fumes, air compression and dirt where fumes cannot be exhausted. ____

18. Please check the extent of inavoidable hazards, if any, associated with the above job classification:

a. Where accidents or hazards to health are negligible ____
b. Having minor health hazards such as minor skin diseases, or where probable accidents are limited to a minor physical degree ____
c. Exposure to lost time accidents such as physical damage ____
d. Exposure to disabling accidents such as loss of arm, a leg, etc., of a partial nature ____
e. Exposure to occupational disease or accidents which would usually result in death or total disability ____

WAGE RATES

The following statements represent possible effects of automation on the wage rates of related employees. For each statement will you please make an (X) under the appropriate answer, (A)gree, (D)isagree, (U)ndecided, based on your experience:

Automation	A	D	U
1. Tends to increase the level of worker wages.	___	___	___
2. Tends to maintain satisfactory relationship between the earnings on each job and advancing workers within rate ranges.	___	___	___
3. Requires methods of wage payment by time rather than by output.	___	___	___
4. Increases labor productivity per worker.	___	___	___
5. Specifically requires less labor cost for existing work loads.	___	___	___
6. Requires less additional labor (cost) for given increases in the work load as business grows.	___	___	___
7. Permits straight time hourly earnings for equitable worker treatment.	___	___	___
8. Creates incentive wage payment difficulties.	___	___	___
9. Permits strict limitation of wage increases to the amounts justified by increases in labor productivity.	___	___	___
10. Permits a more consistent criteria for wage payment on straight time basis rather than on an incentive system.	___	___	___
11. Necessitates new methods of performance evaluation which places greater weight on tangible work factors.	___	___	___
12. Makes present methods of job evaluation inadequate for accurately pricing machine-tending jobs.	___	___	___
13. Requires the redesigning of job description format since work becomes less quantitatively measurable.	___	___	___
14. Greatly reduces the effectiveness of piece rate incentive programs.	___	___	___
15. Increase the effectiveness of group incentive plans.	___	___	___
16. Tends to raise wage rates of machine maintenance people into higher grade levels.	___	___	___
17. Tends to lower machine operators wage rates.	___	___	___
18. Tends to raise layout operators wage rates.	___	___	___
19. Tends to raise machine setters wage rates.	___	___	___
20. Creates jobs with attractive pay scales.	___	___	___

21. The automated job makes payment on a time basis more desirable because:

	A	D	U
a. Units of output are not distinguishable and measurable.	___	___	___
b. Employees have little control over quantity of output.	___	___	___
c. There is no clear-cut relation between effort and output.	___	___	___
d. Work delays are frequent and beyond employees control.	___	___	___
e. Quality of work is especially important	___	___	___
f. Supervisors know what constitutes a fair day's work.	___	___	___
g. Cost control does not require precise advance knowledge of labor costs per unit of output.	___	___	___

22. a. Associated with the introduction of technological change, did you find equitable pay relationships among automated jobs with respect to other manufacturing work?

Yes _____ No _____

b. If Yes, please explain in what way?

23. a. Was there any change in traditional wage differentials on the automated jobs with respect to those which have had long standing acceptance? Yes _____ No _____

b. If Yes, in what way?

24. a. Was a wage payment plan adapted for the Technological change?

Yes _____ No _____

b. If Yes, please explain.

25. a. In your opinion, what is the most desirable wage payment plan to adequately pay workers on automated jobs?

b. Why?

26. Was temporary payment coverage of some sort required to:

a. Train workers? Yes _____ No _____

If Yes, for how long? ____________

b. Did it cover learning and/or prove-in period? Yes___ No___

If Yes, for how long? ____________

27. a. What kind of initial payment coverage was applied?

b. How did this differ from the ultimate or finally accepted wage payment plan?

28. a. Did the initial or temporary wage payment plan help motivate workers in training and prove-in preparatory to acceptance of final wage payment plan? Yes _____ No _____

b. If Yes, how or in what manner?

UNIONS & FRINGE BENEFITS

1. Is the shop where the technological change took place, unionized?

   Yes _____ No _____

2. a. Did the innovation make any difference in union feeling?

      Yes _____ No _____

   b. If Yes, in what way? (Please explain)

3. a. Did the technological change tend to strain work relations?

      Yes _____ No _____

   b. If Yes, in what way? (Please explain)

4. a. Were new labor issues created? Yes _____ No _____

   b. If Yes, what were they?

5. a. Were the work rules changed in any way? Yes _____ No _____

   b. If Yes, please explain.

6. a. Did the automation cause any disunity among workers?

      Yes _____ No _____

   b. If Yes, to what extent?

7. a. Did the automation affect production workers? Yes ___ No ___

   b. If Yes, how? (Please explain)

8. a. Did the technological change create maintenance jobs?

   Yes _____ No _____

   b. If Yes, what kinds of jobs?

9. a. Does automation tend to affect the size of the bargaining unit?

   Yes _____ No _____

   b. If Yes, upwards or downwards?

10. a. Does working in the automated shop create professional pride in the workers?

   Yes _____ No _____

   b. If Yes, in what way?

11. a. Did the technological change affect the number of grievances issued? (Please check one)

   Increased _______
   Reduced _______
   Remained the same _______

   b. List the types of grievances affected.

12. Does automation affect job tension? (Please check one)

   Increased _______
   Reduced _______
   Remained the same _______

13. a. Does automation tend to increase union activity?

Yes _____ No _____

b. If Yes, for what reasons? (Please check)

Wage inequities	________	
Working conditions	________	
Job Hazards	________	
Job Grades	________	
Other	________	(Please explain)

14. a. Did the union play any part in affecting new working conditions due to automation?

Yes _____ No _____

b. If Yes, in what way?

15. What union demands were satisfied by the company?

16. a. From your experience, was there a specific attitude of the union towards job evaluation associated with new automated positions?

Yes _____ No _____

b. If Yes, please explain what it was.

17. a. Did the union contest selection of people for automated jobs with respect to individual ability vs seniority?

Yes _____ No _____

b. If Yes, in what way?

18. a. Was the union asked to participate before ___, at the start___ or after ___ the automation?

b. If Yes, in what way?

APPENDIX II

TYPICAL INSTRUCTION FOR NEWLY
CREATED MAINTENANCE JOBS

MAINTENANCE INSTRUCTIONS FOR AUTOMATIC GAGING-INSULATING MACHINES

The following is an outline to be followed when servicing the B Wire Connector Gaging-Insulating machines. The outline is divided into three sections:

I. Routine Maintenance
II. Trouble-Shooting
III. Critical Adjustments and Maintenance Procedures

I. Routine Maintenance - These machines require a certain amount of regular inspection, cleaning and lubrication which is outside the realm of operator responsibility.

A. Oven Cleaning - Check oven daily. If an oven is severely blackened, remove it and install a clean spare. Run the machine and readjust oven heat settings to the required minimum for proper operation of the equipment. (See Note III - (for oven cleaning procedure.)

B. Inspection of Conveyor Belt. - Bent, cocked or broken pins on the conveyor belt will greatly reduce a machine's efficiency. The condition of these pins must be inspected daily, and necessary corrections made. (See Note III-D for procedure to be followed in replacing pins.)

C. Lubrication. - These machines will complete as many as 250,000 cycles per day; inadequate lubrication under these conditions will result in excessive wear and improper performance of the equipment.

1. Daily Lubrication:

a. Guide pins for feed collet and razor cut-off carrier blocks - oil lightly with spindle oil. DO NOT USE GREASE.

b. Cam bearing on insert feed mechanism - one or two drops of spindle oil

c. Check operation of air solenoids. If their operation is sticky, remove inlet air hose and place a drop of light oil in the solenoid.

2. Weekly Lubrication:

a. Rollers on microswitch #7 and jam switch #2 - one drop of spindle oil.

D. General Inspection - Daily inspect all critical mechanisms of the equipment and make certain that they are performing properly.

II. Trouble-Shooting - The material below is intended as a guide for routine maintenance problems; it does not cover the entire spectrum of machine malfunction.

A. Blow-off Mechanism - (Failure to eject "high" inserts) If there is no air blast, check the microswitch (MS-8) and the slotted trigger pin. The pin may be sticking and will require cleaning and lubrication. If there is an air blast, check the line-up of the air hole. It should be centered on the insert when the conveyor is in dwell position. Improper position indicates either incorrect timing of the Conveyor belt or improper alignment of the assembly containing the air hole. This assembly can be moved by loosening the two hold-down bolts.

B. Jam Switch #2 - (Frequent high shells) - This condition indicates malfunction of the blow-off mechanism. (See Note II-A.)

C. Plastic Feed Mechanism - (Irregular operation) - If operation is irregular or slower than normal, check the associated air solenoids and microswitches. The air solenoids may require lubrication as described in Note I-C. Also, the trigger pin may not be properly aligned with the receiving conveyor pin during dwell. (See Note III-A for proper alignment.)

D. Plastic Feed Mechanism - (Irregular length of plastic) - Check condition of feed collets. They may be dirty or excessively worn. Also, check the alignment of feeding mechanism as described in Note II-C.

E. Plastic Pay-off Mechanism - (Failure) - Check drive motor. This motor should run continuously. If drive will not start, check MS-5. If drive will not stop, check MS-6. If microswitches are good, check clutch relay (CR-8) and brake-clutch mechanism. On prototype machines #1 and #2, the difficulty may be located in the gear reducer unit.

F. <u>Solenoids</u> - (Sticky operation) - Check condition of small spring inside solenoid, if excessively worn, replace. Lubricate the solenoid with light oil.

G. <u>Strippers</u> - These units are made of brass and consequently wear rapidly. When wear becomes excessive, remove and reshape stripping surface to original specifications.

III. Critical Adjustments and Maintenance Procedures

A. <u>Conveyor Belt Timing Procedure</u> - Improper positioning of conveyor pins, will cause assemblies to be misfed and uninsulated. To properly position conveyer pins, it will be necessary to disconnect electrical power to machine. Then manually turn input pulley on conveyor index mechanism to dwell position (dwell is the condition where input pulley turns but output pulley remains stationary). Third, visually check position of conveyor pin at insulating station. (See Figure 1.) This pin is used to activate microswitch under insulating mechanism and should point directly at one of the conveyor pins. If this is not the case, it will be necessary to adjust the position of the conveyer until a pin becomes in line with the activator pin. Adjustment on prototype machine No. 1 is accomplished by loosening the set screw on the large diameter timing pulley which is driven by output pulley of index mechanism and repositioning the belt while setting screw is loose. Once in line, set screw should be resecured to maintain proper alignment. On prototype machine No. 2 adjustment is accomplished by loosening pulley on output shaft of index mechanism and realigning belt in a manner similar to prototype No. 1. Once in line, pulley should then be resecured. (NOTE: It may be necessary to remove pulley and move timing belt to next groove to accomplish proper alignment.)

B. <u>Adjustment of Insulator Mechanism</u> - The trigger mechanism shown in Figure 1 should be adjusted so that the point of the activator pin is approximately .010" from conveyer pin when lock nut is against rear of guide block. This adjustment is best accomplished with tube feed mechanism removed from machine. For proper adjustment on microswitch No. 1, place a shell assembly (with insert) onto pin immediately in front of activator pin. "NOTE: CONVEYOR SHOULD BE IN DWELL POSITION WHILE THIS ADJUSTMENT IS MADE." Next, adjust microswitch No. 1 by loosening adjustment screws shown on Figure 1 so that microswitch No. 1 is just barely activated. Remove shell assembly and replace with empty shell. Microswitch should not be activated when empty shell alone is present. Secure microswitch.

C. <u>Oven Cleaning</u> - Clean the ovens with Kitchen Cleanser and water when the oven is cool.

<u>CAUTION:</u> <u>DO NOT SCRATCH THE BULB WITH CLEANSER OR SCRAPER.</u> When servicing oven, it may be necessary to remove it from machine. Electrical plugs have been provided for quick disconnect of oven, but it will also be necessary to disconnect air line before removal can be accomplished. It is important to reconnect the air once oven has been replaced as overheating will soon occur. Note also that if either skirt or tail is not properly cured, the cause may be either improper focusing of the oven, dirty surfaces within the oven or insufficient voltage applied to radiant bulb.

D. <u>Conveyor Belt Maintenance</u>

1. Insulation of Gage Pins:

Occasionally it will be necessary to replace gage pins on conveyor belt. This can best be accomplished by disconnecting power to machine, removing top guard and shear pin. Empty pins are replaced readily in front of the curing oven. Note pin tip should be 1.10" above surface of belt or 25/32" above gage pin mounting block. Pin should be coated with Locktight and <u>pressed</u> into position. Note also long axis of pin should be parallel to center line of conveyor belt.

2. Splicing of Conveyor Belt.

Should conveyor belt break and require splicing the following procedure should be followed:

a. Disconnect all electrical parts from machine.
b. Remove top guard assembly.
c. Remove shell pin.
d. Manipulate broken end of conveyor belt to a position approximately 2" behind stripper blocks.
e. Remove first two gage pin assemblies from belt at each end of the belt.
f. Trim back the ends of the belt with shears so that .090" material extends beyond end holes on belt and break all four corners with a 45 degree angle. 1/16" tip. (See Figure 2.)
g. Obtain splice segment of belt from spare material available and cut to size (4 stations).

h. Loosen front idler pulley assembly and slide toward rear of machine as far as possible so as to put slack into belt.

i. Place splice material on top of rear end of belt and insert both gage pins through, first the belt and then the splice. Secure gage pins with lock nuts and lock tight in place. Next, pull front end of belt under splice and insert gage pins per No. h above.

j. Tighten belt assembly by positioning front idler forward and locking in place.

k. Rotate belt through complete revolution and check for any handup condition.

l. Replace shear pin, guards and apply power to machine.